MAR 18 1926

Printed on Thin Paper for Foreign Circulation.

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLI.—No. 3662] LONDON: FRIDAY EVENING, MARCH 5, 1926 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

G.I.P. RLY. ELECTRIFICATION.

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E.1, invites TENDERS for :—

STEEL FRAMEWORK FOR ONE TRACTION SUB-STATION.

Tenders due on the 23rd March, 1926, before 2 p.m. Specification and form of Tender obtainable from the above at a fee of 5s., which will not be returned. 1783

G.I.P. RLY. ELECTRIFICAT ON.

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

1. 22 ELECTRIC PASSENGER LOCOMOTIVES.
2. ELECTRICAL EQUIPMENTS for 15 MOTOR COACHES and 42 TRAILER COACHES.

Tenders due on the 13th April, 1926, before 2 p.m., for No. 1, and on the 22rd April, 1926, before 2 p.m., for No. 2.

Specification and form of Tender obtainable from the above at a fee, which will not be returned, of in each case £2 for the first three copies and £1 for each further copy. 1677

SURPLUS W.D. STORES.

Tenders are Invited for the PURCHASE of a RANSOME HORIZONTAL LOG BAND SAW, 'Standard' type, lying at R.E. Workshops, New Rangw, Shoeburyness, Essex. Height, 12ft.; length of travel, 34ft.; width of table, 2ft, 9in.; will take logs up to 4ft. diameter. Some minor parts are deficient.

Can be inspected during working hours at above address on application to OFFICER I/C R.E. STORES, New Rangw, Shoeburyness. 1743

Indian State Railways.

DEPUTY TRANSPORTATION SUPERINTENDENT (TRACTION).

REQUIRED in September, 1926, for service in India with the Great Indian Peninsula Railway, a DEPUTY TRANSPORTATION SUPERINTENDENT to organise work of the Electric Traction Section of the Transportation Department and supervise generally the training of traction staff. Candidates must have had experience in electric traction, power generation, E.H.T. transmission, converting plant, overhead track equipment and the operation and maintenance of electric locomotives and multiple unit stock.

Commencing salary Rupees 1750 calendar monthly, rising by annual increments of Rupees 50 to Rupees 2000. Two years' agreement in first instance. First-class passage to India and home on satisfactory termination of service.

Candidates must be European British subjects and may be required to attend before a Selecting Authority in London at their own expense; also to pass a medical examination if selected for appointment.

The regulations in respect of the appointment and forms of application for use by candidates can be obtained on application to the SECRETARY, Public Works Department, India Office, Whitehall. Applications must reach the India Office not later than 31st March, 1926. 1778

Ministry of Transport.

ROADS DEPARTMENT.

APPLICATIONS are INVITED for a TEMPORARY APPOINTMENT as a DRAUGHTSMAN under the Roads Department of the Ministry of Transport, at commencing wage of £3 per week, for Map and Plan Work in connection with Road Schemes.

Forms of application can be obtained from the ESTABLISHMENT OFFICER, Ministry of Transport, 6, Whitehall-gardens, S.W. 1. Applications can only be received on the recognised forms and should reach the Ministry of Transport on or before the 15th March, 1926. Preference will be given to candidates who have served in His Majesty's Forces. 1758

Required for the Forest Products Research Laboratory, South Farnborough, Hants :—

(A) JUNIOR ENGINEER holding honours degree in engineering, with good standing in mathematics and physics, an intimate knowledge of testing strength of materials, some two or three years' engineering experience, preferably in timber construction or in wood-using industry. Salary £270 per annum inclusive.

(B) JUNIOR ENGINEER holding honours degree in engineering, with good standing in mathematics and physics and a good working knowledge of testing strengths of materials. Salary £250 per annum inclusive. Preference will be given, other things being equal, to ex-Service men.

Applications must be made on a form to be obtained from the SECRETARY, Department of Scientific and Industrial Research, 16, Old Queen-street, Westminster, S.W. 1, and must be returned not later than 20th March. 1744

Vacancies Exist for ASSISTANT ELECTRICAL ENGINEERS in the Admiralty Service.

2. Candidates must have attained the age of 23 years and not more than 40 years of age on the 20th March, 1926. The latter age limit may be extended in connection with the appointment of officers who have specialised in any particular branch of Electrical Engineering, and candidates who have served in the Army, Navy, or Air Force may deduct from their actual age any time which they may have so served.

3. Candidates must possess a University Degree in Engineering or other acceptable equivalent qualification. They must also have had subsequent practical experience in a responsible electrical engineering position for at least three years.

4. Those selected will be appointed on probation for one year, after which, if found suitable, and their retention is desired, will be appointed to the permanent establishment of the Department and be eligible for the ordinary Civil Service superannuation and for promotion to higher grades.

5. Candidates may be required to serve at the Admiralty or Naval Establishment at home or abroad.

6. The salary scale of Assistant Electrical Engineer is £310, rising by increments of £15 annually to £475, plus Civil Service bonus (which varies with the cost of living, and at present amounts to £143 on £310).

7. Preference will be given to ex-Service men.

8. Application forms, which must be completed by all applicants, can be obtained from the SECRETARY of the ADMIRALTY (C.E. Branch), Whitehall, London, S.W. 1, together with the regulations governing the selection, and when filled in should be returned to the same address so as to reach the Admiralty not later than the 20th March, 1926. 1750

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

Electrical Exhibits at the British Industries Fair.
THE ENGINEER, 5 - 3 - 26.

The Consistency of Steam Tables.
THE ENGINEER, 5 - 3 - 26.

Notes on British Railways by a Continental Engineer—No. V.
THE ENGINEER, 5 - 3 - 26.

Back Bay Reclamation, Bombay.
THE ENGINEER, 5 - 3 - 26.

The Navy Estimates.
THE ENGINEER, 5 - 3 - 26.

A Diesel-Electric Locomotive.
THE ENGINEER, 5 - 3 - 26.

The Activated Sludge Process of Sewage Treatment.
THE ENGINEER, 5 - 3 - 26.

An Oil-Fired Water-Tube Boiler.
THE ENGINEER, 5 - 3 - 26.

Marine Turbine Governing.
(MacNICOLL.) THE ENGINEER, 5 - 3 - 26.

PUBLIC NOTICES

The Government of India REQUIRE TWO ASSISTANT FOREMEN for the Shell Forge Section of the Metal and Steel Factory, Ishapore.

(Appointments No. 26 and No. 68.)

QUALIFICATIONS :—

(a) Age between 25 and 30 years, general engineering apprenticeship, experience essential in the working of Hydraulic Presses, Pumps and Accumulators, &c., as used in the manufacture of Forgings for Shells, Base-plates, Diaphragms, and other ammunition components up to 6in. shell size.

(b) Candidates for Appointment No. 26 should have had, in addition to above, experience in the working of Drop Stamps and Trimming Presses.

(c) Candidates for Appointment No. 68 must have had, in addition to the qualifications called for at (a), experience in designing Jigs, Tools and Fixtures, Fitting, Erecting, and Turning, and a knowledge of General Machine Shop Practice.

Terms (in each case) five years' agreement in first instance.

Salary at the rate of Rs. 450-15-510 per calendar month, with prospects of further increases. Free quarters. Free passage to India and return passage on satisfactory termination of services. Medical examination.

Further particulars and forms of application may be obtained from the SECRETARY to the HIGH COMMISSIONER for INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 27th March, 1926. 1765

City of Wakefield Waterworks, EYBURN SCHEME.

CONTRACT NO. 4.—STEEL PIPES.

The Corporation invite TENDERS for the SUPPLY of 725 FEET of 22in. internal diameter and 11,001 FEET of 20in. internal diameter STEEL PIPES, lined with bitumen ⅛in. thick, centrifugally applied, including SPECIAL PIPES for River, Railway, and other Crossings.

Specification, conditions of contract, forms of Tender, and other particulars may be obtained from, and drawings may be seen, at the office of C. Clemesha Smith, M. Inst. C.E., Waterworks Engineer, Town Hall, Wakefield, on and after Friday, February 26th, 1926, on payment of a deposit of Two Guineas, which will be returned on receipt of a bona fide Tender and the documents supplied.

The Corporation do not bind themselves to accept the lowest or any Tender.

Tenders, endorsed "Steel Pipes," to be delivered to me not later than Twelve Noon on Monday, March 15th, 1926.

A. G. ALLIBONE, Town Clerk.

Town Hall, Wakefield, 23nd February, 1926. 1702

PUBLIC NOTICES

The University of Manchester.

(FACULTY OF TECHNOLOGY.)

LEWIS ATKINSON ENTRANCE SCHOLARSHIP IN ELECTRICAL ENGINEERING.

A SCHOLARSHIP of the value of £50 per annum for three years, which has been endowed by the Executors of the late Lewis Atkinson, will be OFFERED this year. The successful candidate will be required to read for the degree of B.Sc., Tech. (Honours Division).

Forms of nomination and application may be obtained from the INTERNAL REGISTRAR, The University, Manchester, to whom they must be returned not later than 1st April, 1926. 1751

Bombay Baroda and Central INDIA RAILWAY.

The Directors are prepared to receive up to Noon on Friday, 12th March, TENDERS for the SUPPLY of :—

WELDLESS STEEL PIPING.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG, Secretary.

Offices : 91, Petty France, Westminster, S.W. 1. 1st March, 1926. 1763

City and County of Kingston- UPON-HULL.

ELECTRICITY DEPARTMENT.

The Electricity Committee of the Hull Corporation invite TENDERS for the :—

CONSTRUCTION of FERRO-CONCRETE and BRICK SUMPS and SHAFTS.

Tender form, general conditions and specification can be obtained upon application to the City Treasurer, Guildhall, Hull, on payment of 10s., returnable on receipt of a bona fide Tender.

The Corporation does not bind itself to accept the lowest or any Tender.

Tenders, addressed "Chairman, Electricity Committee, Guildhall, Hull," and endorsed "Tender for Sumps and Shafts," should be delivered by Noon on Thursday, 18th March, 1926.

H. BELL, M.I.E.E., City Electrical Engineer and Manager.

Electricity Works, Sculcoates-lane, Hull. 1782

PUBLIC NOTICES

SOUTH WALES.

APPOINTMENT OF TEMPORARY ASSISTANT ENGINEER.

Ammanford Urban, Swansea, PONTARDAWE AND LLANDILOFAWR RURAL DISTRICT COUNCILS.

APPLICATIONS are INVITED from qualified and experienced TEMPORARY ASSISTANT ENGINEERS who are capable of carrying out detailed surveys and preparing plans and estimates for a proposed New Road between Ammanford and Pontardulais, in the Counties of Carmarthen and Glamorgan. The salary will be at the rate of £400 per annum. In the event of the works being carried out the successful candidate, if suitable, may be appointed as Resident Engineer to the scheme.

Applications, together with copies of testimonials, must be delivered to the undersigned not later than March 18th, 1926.

Dated this 1st day of March, 1926.

EDWARD HARRIS, Clerk to the Joint Committee.

District Council Offices, Alexandra-road, Swansea. 1761

Chinese Government Railways. PEKIN-MUKDEN LINE.

STORES SUPERINTENDENT REQUIRED IMMEDIATELY for above Railways. Previous railway experience essential. Age not over 38. Free quarters. Three years' agreement. Salary £800, £850, £900.

Address by letter only to "F. D.," c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 1781

The Fire Salvage Association of Liverpool, Limited, is prepared to receive APPLICATIONS for the POSITION of SUPERINTENDENT at their Chief Station. Commencing salary £400 per annum, with house, &c., and good prospects of promotion.

Applicants must not be over 35 years of age and must possess engineering qualifications as well as experience in handling men.

Replies, stating age, height, qualifications and experience, to be addressed to the CHIEF OFFICER, Fire Salvage Association of Liverpool, Limited, 16, Hatton-garden, Liverpool.

Canvassing in any form will disqualify. 1648

Western Australia.

APPLICATIONS are INVITED by the Agent-General for Western Australia for the following POSITIONS in the Public Works Department of the Western Australian Government :—

REFERENCE 2010.—ASSISTANT ENGINEER, with good experience in Design and Construction of Harbour and Dock Works. Salary £600 per annum.

REFERENCE 2011.—ASSISTANT ENGINEER, experienced in Design Large Water Supply Works, Dams and Reservoirs; must be capable Draughtsman. Commencing salary £408, rising to £480 per annum.

REFERENCE 2012.—ASSISTANT ENGINEER, experienced in Design of Large Draining Canals, Irrigation and Hydraulic Work generally; must be capable Draughtsman. Commencing salary £408, rising to £480 per annum.

REFERENCE 2013.—DRAUGHTSMAN, experienced in Design Hydraulic Works, particularly Dams, Reservoirs and Pipe Lines; must also be capable Reinforced Concrete Designer. Commencing salary £408 per annum.

Transport allowance: single man, £75; married man, £150; married man with family, £200. Salary to commence from the date of taking up duty in Western Australia. Should the successful applicants voluntarily relinquish their respective positions before the expiration of 2 years from the date of appointment, they will be called upon to refund the amount of transport allowance.

Applicants must state age and whether married or single. Reference number must also be quoted.

Applications, accompanied by testimonials or references, must reach the AGENT-GENERAL for WESTERN AUSTRALIA, Savoy House, 115-116, Strand, London, W.C. 2, not later than 31st March, 1926. 1764

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, an ASSISTANT ENGINEER for Work in connection with Sewage Disposal Works. The appointment is a temporary one and is at the inclusive rate of £350 per annum.—Applications, stating age, qualifications and previous experience, and enclosing copies of three recent testimonials, to be sent to the CITY ENGINEER, Town Hall, Manchester, not later than 10 a.m. on Wednesday, 10th March, 1926. 1724 A

WANTED, ASSISTANT CIVIL and MECHANICAL ENGINEERS. Applicants must have had extensive experience of the design and construction of large Engineering Works. They must have served a regular pupilage or apprenticeship, which must have included drawing-office experience, and in the case of Mechanical Engineers a thorough workshop training. Preference will be given to applicants who possess a University Degree or equivalent qualification.

Applications should be addressed 1767, The Engineer Office, and should state full particulars of education, technical training, experience, war service, and salary required. 1767 A

SITUATIONS OPEN (continued) Page 2.

SITUATIONS WANTED, Page 2.

AGENCIES, Page 2.

MACHINERY, &c., WANTED, Page 2.

PARTNERSHIPS, Page 2.

AUCTIONS, Page 98.

FOR SALE, Pages 2, 3 and 98.

BUSINESSES and PREMISES (For Sale, etc.), Page 98.

PATENTS, Page 2.

WORK WANTED, Page 3.

For Advertisement Rates see Page 271, Col. 1.

INDEX TO ADVERTISEMENTS Page 97.

SITUATIONS OPEN (continued)

WANTED by Old-established Firm of Crucible Steel, &c., Manufacturers, REPRESENTATIVE for Lancashire.—Address, stating experience, which is essential, 1747, The Engineer Office. 1747 A

WANTED, ESTIMATORS in Civil, Structural and Mechanical Engineering Work. Applicants must have had extensive experience in similar work. They must have served a regular pupilage or apprenticeship, which must have included drawing-office experience and, in the case of Estimators for Mechanical Engineering, a thorough workshop training. Preference will be given to applicants who possess a University Degree or equivalent qualification.
Applications should be addressed 1768, The Engineer Office, and should state full particulars of education, technical training, experience, war service, and salary required. 1768 A

CEMENT TRADE.—A Large English PORTLAND CEMENT COMPANY, operating outside of the C.M.F., REQUIRE REPRESENTATIVES for Nottingham, Leicester, Birmingham, and Northampton areas, and southwards to the London border; also for Manchester and Sheffield districts. Only those who have established connections will be considered.—Applications (which will be treated as strictly confidential), giving full particulars and salary required, to be addressed to 1748, The Engineer Office. 1748 A

ELECTRICAL LIFT MANUFACTURERS REQUIRE experienced MANAGER to take sole internal control. Progressive position for right man.—Apply in writing, stating age, qualifications, and salary required, to T. MAY and CO., Prudential Chambers, Leicester. 1737 A

ENGINEER SALESMAN, Accustomed to Deal with London architects and engineers in connection with high-class equipment for Hotels, Shops, Theatres, Offices, &c. Excellent opening for keen young man.—Address, stating experience, age, salary required, 1769, The Engineer Office. 1769 A

TRAVELLER (London District), with Connection among Engineers and Manufacturers, to Sell Welding Plants and Accessories.—Address full particulars, 1784, The Engineer Office. 1784 A

WANTED, First-class MACHINE DRAUGHTSMAN, with original ideas and inventability. Only men with a good record need apply.—Address, 1755, The Engineer Office. 1755 A

WANTED IMMEDIATELY, First-class DRAUGHTSMAN, design of Heavy Castings, Machinery, and Structural Work. Good experience and references essential. Applications from London area only.—Address, 1792, The Engineer Office. 1792 A

WANTED, JUNIOR DRAUGHTSMAN, Preferably with experience in Cement Works Plant.—Apply, giving particulars of experience and salary required, to MAXTED and KNOTT, Ltd., Dunstable. 1770 A

COMPETENT DRAUGHTSMAN REQUIRED, thoroughly experienced in Road Rollers and Traction Engines. Must be quick and accurate.—Address, stating age, experience, and salary required, 1749, The Engineer Office. 1749 A

DRAUGHTSMEN.—BEFORE NEGOTIATING with Government Departments in connection with any post, PLEASE COMMUNICATE with the GENERAL SECRETARY, Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, London, S.W. 1. 1169 A

DRAUGHTSMAN, Experienced in Marine Diesel Engine design. Salary £5 to £5 10s. per week. State age and experience.—Address, P1620, The Engineer Office. P1620 A

DRAUGHTSMAN, with All-round Experience of the design and construction of Electrical Generators and Motors, REQUIRED by old-established firm. State full particulars of experience and salary required.—Address, 1698, The Engineer Office. 1698 A

HEAD DRAUGHTSMAN for Machine Tool Firm: Good experience and thorough all-round knowledge essential. Must be good organiser, systematic, and disciplinarian. Applications, which will be treated in strict confidence, should give fullest particulars of experience, qualifications, &c., also age and salary.—Address, P1656, The Engineer Office. P1656 A

REQUIRED, TWO JUNIOR DRAUGHTSMEN, with Motor Car or Aero-engine experience.—Address, stating age, experience, and salary required, 1756, The Engineer Office. 1756 A

WANTED, Thoroughly Experienced FOREMAN MILLWRIGHT, conversant with Modern Machine Tool Design and General Plant Repairs. Must have electrical experience, to Take Charge of Power and Lighting Plant in Shops.—Write, stating age, experience, salary expected, and when free, to "MILLWRIGHT," c/o Dixon's, 103, Oxford-street, W. 1. P1640 A

FOREMAN WANTED, Thoroughly Capable Man, for Machine and Fitting Shops producing Heavy and General Engineering Work. Men accustomed to repetition work only need not apply. Applicants to state age, full details of experience and training, where obtained, and salary expected.—Write, Box 1557, Sells, Fleet-street, E.C. 4. 1753 A

WELDING FOREMAN WANTED for North England; an energetic foreman to Take Charge of the Welding Department of large Lap-welded Tube Plant, water gas process. State experience and wages required.—Address, 1615, The Engineer Office. 1615 A

WANTED for S. America, Practical MECHANIC, age 25/30, Take Charge of Nail-making Plant. Experience of Tool Treatment essential. In reply give full particulars.—Address, 1762, The Engineer Office. 1762 A

WELDERS. — OXY-ACETYLENE WELDERS WANTED for Tube Works, North England. Only men capable of making and finishing specials need apply. State wages and experience.—Address, 1616, The Engineer Office. 1616 A

SITUATIONS WANTED

COMBUSTION ENGINEER (33). Sound Tech. training and excellent experience in modern boiler plant equipment and operation, chemistry of all classes of fuels, also constructional work, &c., keen and energetic, DESIRES POST with Engineering Firm or Consultants.—Address, P1665, The Engineer Office. P1665 B

CONSTRUCTIONAL STEEL WORK.—First-class MAN, Practical and Technical, DESIRES POST as CHIEF ENGINEER or CHIEF DESIGNER.—Address, P1669, The Engineer Office. P1669 B

ENGINEER, Age 27, Single, G.M.I. Mech. E., Four years university, three years shops, D.O., foundry and test, in large turbine-electric works. Further experience in erection on site. DESIRES POSITION with prospects, overseas no objection.—Address, P1643, The Engineer Office. P1643 B

ENGINEER, B.Sc., with Three Years' Experience on dock and main drainage works, SEEKS POSITION as Assistant Engineer, Resident, or Contractor's Engineer, at home or abroad.—Address, P1661, The Engineer Office. P1661 B

ENGINEER SALESMAN, M.I. Mech. E., with design and practical experience and of proved selling ability, DESIRES CHANGE. Wishes to Represent Firm of Repute; excellent record.—Address, 1779, The Engineer Office. 1779 B

ENGINEER (36), Qualified, Mechanical Marine (1st Class B.O.T.), with many years' experience abroad, DESIRES POST, England.—Address, P1662, The Engineer Office. P1662 B

SITUATIONS WANTED (continued)

ENGINEER MANAGER SEEKS Progressive POST abroad; 14 years' practical and commercial experience, past three years ginnery manager, Africa. Experience cotton buying, ginning, erection, maintenance plant and machinery, steam, suction gas, &c. First-class credentials.—Address, P1655, The Engineer Office. P1655 B

ENGINEER (33) SEEKS Responsible POSITION; used to control of staff, planning, tools, organising, &c.; shop experience, energetic, light engineering.—Address, P1663, The Engineer Office. P1663 B

ENGINEER SALES MANAGER DESIRES POSITION. Experienced technical and commercial aspects goods handling plant, conveyors, hoist blocks, &c. Can take entire control production, sales, estimating, publicity, and administration.—Address, P1623, The Engineer Office. P1623 B

MECHANICAL ENGINEER (29), Excellent Tech. education, 1st Class B.O.T. Cert., experience with reciprocating, turbine and I.C. engines, boilers and pumping machinery, DESIRES progressive POST.—Address, P1648, The Engineer Office. P1648 B

METALLIFEROUS MINING ENGINEER, SURVEYOR and ASSAYER (26) DESIRES POSITION, C.S.M. Diploma, C. and G. Cert.; experienced in dressing plant, blasting, pneumatic drills, good mech. engineer.—Address, P1664, The Engineer Office P1664 B

PRACTICAL MECHANICAL ENGINEER SEEKS SITUATION; 25 years' experience with locomotives, home and abroad; Locomotive Foreman and Inspector. Excellent character, age 41.—Address, P1585, The Engineer Office. P1585 B

SALES ENGINEER DESIRES CHANGE. Extensive practical experience in electrical and mechanical engineering. Speaks fluent Spanish. Selling experience at home and abroad.—Address, P1659, The Engineer Office. P1659 B

WORKS and SALES MANAGER, M.I. Mech. E., A.M.I.C.E., proved ability administration, control and organisation from design to completed sales (special experience public works plant, roadmaking and road transport equipment), DESIRES PLACE his PERSONALITY and EXPERIENCE at home or abroad in a managerial or representative capacity where energy and scope will justify a substantial remuneration.—Address, P1650, The Engineer Office. P1650 B

YOUNG ENGINEER, Who Has Had First-class experience in works, D.O., purchasing and other departments, and has successfully controlled such departments, DESIRES to GET INTO TOUCH with FIRM having any VACANCY offering scope and prospects. Full details of experience by letter or at interview.—Address, P1644, The Engineer Office. P1644 B

YOUNG MAN (21), Technical and Practical Training, SEEKS POST, Junior Draughtsman in Mechanical Engineer's Office.—H. B., 7, Buckingham Palace-gardens, S.W. 1. P1605 B

DRAUGHTSMAN, with Shop Training and Sound theoretical knowledge, DESIRES permanent progressive POSITION in London, to enable himself to complete studies for M.I.M.E.—Address, P1642, The Engineer Office. P1642 B

LADY TRACER SEEKS WORK; Cons. Wkr. Can send specimens of tracing and letter of recommendation.—D., 25, Alexandra-road, Gloucester. P1666 B

TOOL DESIGNER, Aged 38, Wide Experience in design, manufacture and inspection of press tools, jigs and fixtures, moulds, &c., 8 years in charge, REQUIRES responsible POSITION.—Address, P1645, The Engineer Office. P1645 B

EDUCATIONAL

COACHING in CIVIL ENGINEERING SUBJECTS. —To G. W. M. BOYCOTT, Assoc. M. Inst. C.E., Chandos House, Palmer-street, Westminster, S.W. 1. 1715 E

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric., Inter B.Sc.), and ALL ENGINEERING EXAMINATIONS, personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Eng., London, Assoc. M. Inst. C.E., Chartered Civil Engineer, M.R.S.I., F.R.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams., comprising hundreds of successes. Courses may commence at any time.—Apply to Mr. TREVOR W. PHILLIPS, B.Sc. (Hons.), A.M.I.C.E., &c., 8/11, TEAFFORD CHAMBERS, 58, SOUTH JOHN-STREET, LIVERPOOL. Telephone No. 1118 Bank. EX. E

LEARN SURVEYING and LEVELLING.—Thorough practical instruction by expert.—E. MOUL (late L.S.W. and S.P.D. Rly.), Hollybank, Woking. P1334E

PITMAN'S POSTAL COURSE IN ENGINEERING DRAWING.—My old-established and intensive course in Mechanical Draughting and Machine Design is of the greatest value to all those preparing for examinations, or who are employed in the daytime and are anxious to obtain a more interesting and profitable occupation. Students prepared for all Engineering examinations. The course may be started at any time.
Send for particulars and enrolment form.
PITMAN'S, 25, Victoria-street, London, S.W. 1.

PARTNERSHIPS

IF YOU ARE SEEKING
A PARTNER or PARTNERSHIP
or wish to buy or sell a
BUSINESS or WORKS
Write:
WHEATLEY KIRK, PRICE & CO.,
46, Watling Street,
London, E.C. 4.
Established over 70 years.

WANTED, ACTIVE PARTNERSHIP in ENGINEERING FIRM by MECHANICAL ENGINEER, age 28.
Good training, experience, and references. About £5000 available.
Address, P1657, The Engineer Office. P1657 C

ENGINEERING HOUSE in London with Financial agency business SEEKS additional PARTNER for their City office; £500 essential. Under own control.—Address, P1670, The Engineer Office. P1670 C

MECHANICAL ENGINEER (31), Good General experience, DESIRES POSITION in established concern. Capital £1000, if required. Fullest investigation.—Address, P1647, The Engineer Office. P1647 C

OLD-ESTABLISHED BUSINESS FIRM, Government Contractors, with offices in the heart of Westminster, London, REQUIRE ADDITIONAL CAPITAL to complete valuable orders in hand for Patented Machine (Patent No. 239,796, April 7th, 1925). Chance of making big money in royalties. Principals only write.—Address, 1791, The Engineer Office. 1791 C

PARTNERSHIPS and ACTIVE DIRECTORSHIPS WANTED in Mechanical, Constructional, Electrical Engineers, &c., for Clients with technical experience and capital from £1000 to £20,000.—GILBERT and PRATT, 18, Walbrook, London, E.C. 4. Ex. C

AGENCIES

ADVERTISER, with Excellent Connection Textile trade, collieries, shippers, &c., having worked Lancashire and N. Midlands for 7 years, is now OPEN to ACT as AGENT for One or Two First-class Engineering Firms for power plant, &c.—Address, P1629, The Engineer Office P1629 D

ENGINEER, Resident in Sheffield and Calling regularly on collieries and factories, with own car, in South Yorkshire, Nottinghamshire, and Derbyshire, WISHES to FIX UP an additional AGENCY with established Firm of Engineers manufacturing specialities, plant, &c.—Address, P1646, The Engineer Office. P1646 D

ENGINEER, Widely Travelled, International experience, shortly proceeding to CANADA, is OPEN to REPRESENT FIRM of repute or UNDERTAKE MISSION involving ability and tact. Will also UNDERTAKE INSPECTION and REPORTS or PROPAGANDA.
All communications treated in strict confidence. Full information given. Kindly give week's notice for interview.
Address, P1667, The Engineer Office. P1667 D

GENERAL AGENT WANTED for Patented Boiler Fitting Article abroad, successfully introduced already.—Applications, with references about connection to railways, industries, &c., to Box No. 425, c/o White's, 33, Fleet-street, E.C. 4. 1763 D

MANUFACTURERS' AGENCY. Established Over 40 years in well-organised offices in best Westminster position, has VACANCY for a REPRESENTATION. Long-standing connections with railway companies, home and abroad, Government Departments, consulting engineers and contractors.—Address, P1653, The Engineer Office. P1653 D

MANUFACTURERS of PLANT for Greatly Increased Boiler Efficiency SEEK energetic SALES ENGINEER, well connected with steam users, as London agent. Ground prepared, waiting to be followed up. Home counties agencies also open.—Write full particulars, Box 1975, Sells, Fleet-street, E.C. 4. 1776 D

OWNERS of BRITISH PATENTS of "Furnace Grates for Gas Producers," showing phenomenal economies in fuel and labour, DESIRE APPLICATIONS for DISTRICT AGENCIES from substantial and established Firms with large connections in Steel, Smelting, Glass and other Heat-using Industries.—Address, P1658, The Engineer Office. P1658 D

TO MACHINERY BUYERS ABROAD.—Have Your own Buying Agents in London. We have been established over quarter of a century and Purchase, Inspect, and Ship every description of Machine Tools, Motor Cars, Railway Material, and every description of Engineering Supplies. We can probably save you a considerable sum of money annually. We also save your time, trouble, and prevent mistakes. Correspondence is invited with regard to terms, finance, and shipping.—P. PITMAN and CO., 25, Victoria-street, London, S.W. 1. 1790 D

COX & DANKS
Ltd.

beg to announce
that they have purchased 200 300 tons of

NEW MILD STEEL CIRCULAR PLATES

varying in thickness from 3/16in. to 5in. and in size from 3ft. 6in. to 5ft. 6in.

THEY ARE SUITABLE FOR MANY ENGINEERING PURPOSES AND FULL PARTICULARS WILL BE SUPPLIED ON APPLICATION.

Head Office: 168, REGENT STREET, LONDON, W.1.

Branches: SHEFFIELD, BRADLEY HEATH, BIRMINGHAM, MANCHESTER, QUEENBOROUGH, SCAPA FLOW.

PATENTS

PATENT YOUR INVENTIONS. Trade Mark Your Goods. Advice, handbooks, and cons. free.—B. T. KING, C.I.M.E. Regd. Patent Agent, G.B., U.S.A., and Canada), 146A, Queen Victoria-street, London, E.C. 4. 40 years' references. Phone: Cent. 682. 1166 H

THE PROPRIETOR of PATENT No. 197,423, "Steam Generators," is DESIROUS of ENTERING into ARRANGEMENTS by way of LICENCE and otherwise on reasonable terms for the purpose of EXPLOITING the same and ensuring its full development and practical working.
All communications should be addressed in the first instance to J. E. EVANS-JACKSON and CO., Registered Patent Agents, Bath House, 57/60, Holborn Viaduct, London, E.C. 1. 1716 H

THE PROPRIETOR of BRITISH PATENT No. 183,601, dated May 2, 1921, relating to "Improvements in Disk Wheels," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 1676 H

THE PROPRIETORS of LETTERS PATENT No. 194,718, relating to
"IMPROVEMENTS IN LUBRICATORS,"
DESIRE to DISPOSE of their PATENT or to GRANT LICENCES to interested parties on reasonable terms for the purpose of EXPLOITING the same and ensuring its full commercial development and practical working in this country.
Enquiries to be addressed to
CRUIKSHANK and FAIRWEATHER,
Chartered Patent Agents,
65-66, Chancery-lane, W.C. 2. 1738 H

THE PROPRIETOR of PATENT No. 193,414, for "Improvements in and relating to Turbine Impellers with Adjustable Vanes," is DESIROUS of NEGOTIATING with interested parties for the GRANTING of LICENCES thereunder on reasonable terms.—For information apply to Messrs. LLOYD WISE and CO., Chartered Patent Agents, 16, New-court, Lincoln's Inn, London, W.C. 2. 1742 H

THE PROPRIETOR of BRITISH PATENT No. 192,309, dated March 8, 1922, relating to "Improvements in Machines for Coating Wafers and for Making Sandwich Wafers," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to B. SINGER, Steger Building, Chicago, Illinois. 1745 H

THE PROPRIETORS of BRITISH PATENTS No. 197,326, dated May 6, 1922, relating to "Improvements in Slug Detectors for Coin Controlled Machines;" and No. 197,327, dated May 6, 1922, relating to "Improvements in Slug Detecting Device for Coin Controlled Machines," are DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patents and ensuring their practical working in Great Britain.—Inquiries to Mr. B. SINGER, Woolworth Bldg., New York, U.S.A. 1746 H

THE PROPRIETOR of BRITISH PATENTS Nos. 196,577 and 209,110, dated April 24, 1922, relating to "Improvements in Locomotives;" and Patent No. 209,111, dated April 24, 1922, relating to Improvements in Turbine-electric Locomotives," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patents and ensuring their practical working in Great Britain.—All inquiries to be addressed to Mr. B. SINGER Woolworth Bldg., New York City, N.Y., U.S.A. 1752 H

THE PROPRIETOR of the PATENT No. 161,149, relating to "Axle Bearing for Trolleys, Field Railway Trucks, and the like," DESIRES to ENTER into ARRANGEMENTS by way of LICENCE and otherwise for the purpose of EXPLOITING the same and ensuring its full development and practical working in this country.
For particulars apply, C. LEAN, 231, Strand, London, W.C. 2. 1754 H

"THE ENGINEER."

VOLUMES OF "THE ENGINEER."
WANTED, Any or All of the VOLUMES (Bound or unbound, but complete) of "THE ENGINEER," 1914 (Vols. 117-8) to 1924 (Vols. 136-7), inclusive.—Address, P1699, The Engineer Office. P1699

MACHINERY, &c., WANTED

WANTED, SIDE PLANING MACHINE, Screw driven, capable of planing 4ft. 6in. square (or nearest) in one setting.—Address full particulars, price, and where can be seen, 1757, The Engineer Office. 1757 F

WANTED, 7ft. 6in. by 4ft. 6in. VERTICAL BOILER, Spencer-Hopwood or multitubular type, for 100 lb. working pressure, complete with all fittings.—JOHN SHELBOURNE and CO., 29, Marklane, E.C. 3. 1759 F

PAIR HORIZONTAL PLATE BENDING ROLLS, belt or motor driven, suitable for bending plates 1in. thick, rolls 20ft. long. Fullest particulars, lowest price.—THOMPSON BROS. (Bilston), Ltd., Bilston. 1780 F

REQUIRED IMMEDIATELY, Sufficient STEEL SHEET PILING to pile 250ft. run, piles 25ft. to 35ft. long. Must be good condition.—Address, 1786, The Engineer Office. 1786 F

FOR HIRE

APPLY to RICHD. D. BATCHELOR, ARTESIAN WELL & CONSULTING ENGINEER (WATER SUPPLIES EXPERT).
All equipments for improving your Water Supply.
Largest Well Boring Plant, 3in. to 9ft. diam.
Every Description of Pumping Plant.
73, Queen Victoria-st., E.C. 4; & Chatham.
'Phones: Central 4905; Chatham, 71.
Wires: Borehole, London; Watershed, Chatham.
ESTAB. OVER 14 CENTURIES.

FOR HIRE, PUMPS and WELL-BORING TOOLS for Contractors' Deep Wells, &c., 2in. to 24in. dia.—E. RICHARDS and CO., Upper Ground-street, London, S.E. Telephone No. 975 Hop. 822 K

FOR SALE or HIRE, ELECTRIC MOTORS, from 60 to 300 H.P.; PORTABLE STEAM ENGINES, from 8 to 40 N.H.P.; STEAM BOILERS, CRANES, PUMPS, MACHINE TOOLS of every description; reasonable terms, immediate delivery.—J. T. WILLIAMS and SONS, 37, Queen Victoria-street, London, E.C. Tel., City 3038. Ex.

FOR SALE

FOR SALE.—
ONE LANCASHIRE BOILER, 30ft. by 8ft., for 140 lb. pressure.
THREE DITTO, 30ft. by 7ft. 6in., for 120 lb. pressure.
THREE DITTO, 22ft. by 7ft., for 100 lb. pressure.
ONE CORNISH BOILER, 15ft. by 5ft., for 80 lb. pressure.
ONE New 2-Ton Wilton-Kramer LIFTING MAGNET with HIGH-SPEED ENGINE and 6 K.W. GENERATOR, 220 volts, complete with Cable and Drum.
Apply, W. KAYLEY, Queen-street Ironworks, Chancery-lane, Ardwick, Manchester. 1171 G

For continuation of For Sale Advertisements see page 3.

A Seven-Day Journal

Threatened Engineering Lock-Out.

As a result of a demand for the abolition of non-union labour coupled with one for an increase of wages and the refusal of the management to take local action while national negotiations were in progress, about nine hundred workers in the London establishment of R. Hoe and Company, printing-press manufacturers, stopped working in January. On Friday of last week, February 26th, the Engineering and Allied Employers' National Federation decided to post lock-out notices in all the federated engineering establishments throughout the country against the members of the seven unions involved in the dispute. These unions are the Amalgamated Engineers', Pattern Makers', Electricians', Municipal and General Workers', Workers', Transport and General Workers' and Brass and Metal Mechanics'. The notices were to be posted to-day, Friday, March 5th, and were to take effect on Saturday, March 13th, unless in the meantime a settlement was arrived at. The strike at Messrs. Hoe's works has not received the support of the men's unions, and dispute benefit is being withheld. The unions hold that the strike is a breach of the Provisions for Avoiding Disputes embodied in the National Agreement of 1922. On Monday the strikers, at a mass meeting, decided to persist in remaining away from work and to refuse to accept any advice from their unions to return. On Tuesday the trade unions concerned held a joint conference in London, under the chairmanship of Mr. J. T. Brownlie, of the Amalgamated Engineering Union, the body to which the bulk of the strikers belong. After reviewing the position the conference was adjourned until to-day—Friday. It is certain that among the union representatives and the members of the unions generally throughout the country, there is a full realisation of the gravity of the threatened lock-out, and a strong desire that Messrs. Hoe's men should resume work and continue negotiations under the established procedure. It is to be inferred, however, that there is a certain volume of feeling in the opposite direction. The situation is similar to that created some time ago by the Southampton shipyard workers, but it is too early to say that it will probaly have a similar conclusion.

The World's Warships.

THE 1926 edition of the blue book, "Fleets (the British Empire and Foreign Countries)," which was issued on Monday, contains the usual fund of information as to British and foreign naval progress. Of special interest are the details relating to certain British vessels of recent construction, now revealed for the first time. The cruiser-minelayer Adventure, which was launched in 1924, has a displacement of 6740 tons, geared-turbine machinery of 40,000 horse-power, and a designed speed of 27·75 knots. Her armament is shown as four 4·7in. guns and sixteen 3-pounders and machine guns, which is considerably lighter than had been anticipated; but she will, of course, carry a large supply of mines. The new destroyers Amazon and Ambuscade, launched in January last, are of 1330 and 1210 tons respectively. They are designed for the exceptionally high speed of 37 knots, and their armament comprises four 4·7in. and seven 2-pounders and machine guns, with two triple torpedo tubes. The submarine tables tend to lengthen year by year, owing to the great number of these vessels which have been added to foreign navies since the war. France alone has 58 under construction and projected, Japan 26, Italy 20, Great Britain 10, and the United States 4. The latest American boats are the largest laid down, so far, for any navy. They have a surface displacement of 2890 tons—365 tons more than the British X 1—and speeds of 15 to 17 knots. The American V 4, which is designed for minelaying, will carry one 6in. gun, four torpedo tubes, and 60 mines. No particulars are divulged of the battleships Nelson and Rodney or of the new "County" class cruisers now under construction. The swiftest cruisers shown as under construction are the Italian Trento and Trieste, which are to be engined for 150,000 horse-power and a speed of 36 knots.

The New Lloyd Sabaudo Liner.

THE recent announcement that the Lloyd Sabaudo Company of Genoa has placed an order for a new passenger liner with the Stabilimento Tecnico Triestino yard at Trieste, while satisfactory for the Italian shipbuilding industry, is nevertheless a loss for the Clyde. It had been hoped that the new ship would have been constructed at Dalmuir by William Beardmore and Co., Ltd., who built for the company the three notable vessels Conte Rosso, Conte Verdi, and Conte Biancamano. The decision, we gather, was influenced by national rather than technical considerations, for certainly the Lloyd Sabaudo Company has reason to be very proud of its three Beardmore ships, the last of which, the Conte Biancamano—described in our issues of November 13th and 20th, 1925—has proved in service to be particularly economical. Her consumption of oil fuel on a nine days' voyage from New York to Genoa worked out at 0·77 lb. per shaft horse-power per hour, which we believe to be a record figure for a double-reduction geared turbine ship. According to the published figures, the new liner is to be slightly larger than her sister vessels. Her length will be about 680ft., with a measurement of 24,000 gross tons. She will be fitted with twin-screw geared turbine machinery, designed for a service speed of about 21 knots. The passenger accommodation will be arranged for 200 passengers *de luxe*, 200 first-class, and 200 second-class, whilst 900 third-class passengers and about 800 steerage passengers will also be carried.

The Comptroller-General of Patents.

IT is intimated that the Board of Trade has appointed Mr. William Smith Jarratt to be Comptroller-General of Patents, Designs and Trade Marks in succession to Mr. W. Temple Franks, who retired from the office on the first of this month, on account of ill-health. Mr. Jarratt was a Scholar and Wrangler of Trinity College, Cambridge, and obtained a first-class in the Natural Science Tripos. In 1910 he was called to the Bar. For some time he served as an Examiner in the Patent Office, and for the past four years he has been Assistant Comptroller in charge of Trade Marks and Designs. Mr. Jarratt is not a specialist in any particular branch of science, but possesses a wide knowledge, both of science and technology generally. Mr. Franks was born in 1863, and was educated at Dulwich and Wadham College, Oxford. He was called to the Bar in 1890, and after practising on the South-Eastern circuit for twelve years, was appointed assistant librarian at the House of Commons in 1902. From 1905 to 1909 he served as secretary to the Railway Companies Association, a post with which for two years he combined the duties of lecturer on railway law and history at the London School of Economics. He served on various Government Committees and Conferences, notably on the Board of Trade Railway Conference of 1908, the Departmental Committee on Railway Amalgamation of 1909, the Economics Section of the Peace Conference of 1919, and on the Royal Commission on Awards to Inventors from 1919 to 1920.

Three Months' Wreck Statistics.

THE returns issued this week by Lloyd's Register of Shipping showing the number and gross tonnage of ships of 100 tons and over lost, condemned or otherwise removed from the world's total tonnage of shipping during the quarter extending from July 1st to September 30th, 1925, show, as usual, that while this country suffered the highest total loss of tonnage, relatively to the total owned, it escaped fairly lightly. Taking steamers and motor ships only—to the exclusion, that is, of sailing ships—we find that Great Britain lost five vessels of a total tonnage of 12,619, representing 0·06 per cent. of the number of steamers and motor ships owned and 0·07 of the total tonnage. Relatively Japan was the worst sufferer, for with eight vessels of 7993 tons total, she lost 0·38 per cent. of her total number and 0·20 per cent. of her total tonnage. The world's total loss of steamers and motor ships amounted to 40 vessels of 41,360 aggregate tonnage. In the same quarter 19 sailing ships of 14,823 tons were lost, of which none belonged to this country. It will be noticed that while the average size of the steamers and motor ships lost was about 1030 tons, this country was exceptional in that the five vessels lost averaged more than double the general mean figure. This fact is accounted for by the wreck of two large British ships, the Egremont Castle, of 5294 tons, and the City of Leeds, of 4809 tons. The figures we have quoted do not include vessels broken up, condemned, &c., unless such breaking up, &c., was consequent upon a mishap caused by stress of weather, or other accident. The number of steamers and motor ships voluntarily broken up, &c., during the quarter amounted to 55 of 106,895 tons total, of which 17 of 33,929 tons belonged to Great Britain. More than half the British tonnage under this heading is accounted for by the breaking up of two vessels, the Grampian, of 10,955 tons, and the Caledonia, of 7622 tons.

The Future of Shipbuilding.

IN the course of his remarks at the annual meeting of the British Corporation for the Survey and Registry of Shipping, recently held in Glasgow, Mr. Robert Clark, the chairman, made some interesting observations on the possible trend of future shipbuilding. The present position was, he thought, obscured by the declared advice of shipping authorities to shipowners, which ranged on the one hand from building no ships at all to the opposite extreme of building all the ships for which money could be found or borrowed. His own opinion was that the future would be determined by private judgment of the requirements of supply and demand, but statistical facts might help. An analysis of pre-war conditions showed that the average trade of the world had for long been carried in some 30,000 ships, of which about 12,000 were of less than 1000 tons apiece. For every ship that went out of commission a new ship was built, and shipbuilding returns gave an average annual output of 1330 vessels. The new ships were larger than the old, so that the gross measurement of the whole 30,000 ships was increased by about 1,330,000 tons each year or by 1000 tons per new ship. The recent reduction in the annual number of new ships built from 1330 to 830 had brought down the large post-war increase in the number of ships afloat to a total of 33,000 in 1925, but the abnormal quantity of new ships inherited from the war production period had tended to bring the number of ships removed from the active list under the average. Mr. Clark was of the opinion that these facts and figures, if taken in conjunction with the natural increase in population and its requirements, showed despite the low freights now in force, that the shipping industry was approaching a time when more tonnage, if not more ships, would be needed.

Some More Long Distance Flights.

WHILE Mr. Cobham, who left this country on November 16th on a de Havilland machine and arrived at Cape Town on February 17th, is now flying home again, an expedition of four Fairey machines, belonging to the Royal Air Force, has begun a flight from Cairo to the Cape. The route to be followed by the Air Force machines will be practically identical with that chosen by Mr. Cobham, and indeed with that prepared in 1919 for the Van Ryneveld-Brand flight. The object of the flight is understood to be to test the organisation necessary for the movement of a number of aeroplanes over a long route, but the expedition may also serve as a preliminary step towards the establishment of a regular air service between Cairo and the Cape. The machines left the Heliopolis Aerodrome on Monday morning, March 1st, but it is intended that the journey shall be taken leisurely. The programme anticipates that Cape Town will be reached on April 12th, and that the return journey will be begun on April 19th and completed on May 2nd. The total distance to be covered will be 10,800 miles. In contrast with this distinctly slow flight, we have to record an attempt also begun on Monday morning by two Air Force officers to fly from Karachi in India to England, a distance of over 5000 miles, in five days.

Salving the Monitor Glatton.

DURING the fine spell of weather at the end of last week, further progress was made in the raising of the monitor Glatton, which was sunk in the naval harbour at Dover during the war, following an explosion and a fire. The salvage operations were carried out by the Dover Harbour Board under the supervision of the harbour master. In the course of the summer of last year the hull was sealed and compressed air was admitted to assist the refloating operations. Work was abandoned, however, during some part of the winter, and a temporary danger light was placed on the wreck. On Friday last, with the assistance of lifting lighters and salvage tugs, it was possible to tow the hull some 800ft. shoreward. It is hoped eventually to bring the hull of the Glatton alongside the wall of the submarine dock, so that it can be dismantled and broken up.

Wireless on Trains.

ON Tuesday, March 2nd, the Great Western Railway Company once more demonstrated the possibility of wireless reception on trains. The Cornish Riviera express was equipped with five loud speakers, placed in the dining cars, and twenty pairs of headphones were installed in the first-class carriages. During the journey to Plymouth the reception suffered somewhat as the result of the inductive effect of the train lighting generators, but the trouble is said to have been overcome before the train left Plymouth for Paddington, and the Daventry station was successfully and clearly picked up at a distance of 226 miles from London. A solo relayed from the London station to Daventry was audible whilst the train was passing through the Brent Tunnel. At Newton Abbot the reception of a pianoforte solo from Paris was perfect, and throughout the journey reception was consistently good.

A Presentation to Mr. Harry Booth.

AT the Institution of Electrical Engineers on Friday, February 26th, a presentation was made by Sir Henry Renwick to Mr. Harry Booth, on behalf of his many friends representing every branch of the electrical industry. The period of Mr. Booth's official life covers almost the entire history of electricity supply in Great Britain, and it has been his privilege, first under the Board of Trade, and later under the Ministry of Transport, to be closely associated with the legislative and administrative phases of electrical progress. His intimate and exceptional knowledge of the Electricity Acts and regulations governing electrical enterprise has been of the greatest value and assistance to the electrical industry, which has materially benefited by the more liberal legislation of recent years. In making the presentation, Mr. Booth's friends expressed through the medium of Sir Henry Renwick their deep appreciation of the loyal and painstaking service he has rendered to the development of the industry, and assured him that he would carry with him in his well-earned retirement their gratitude and esteem.

British Industries Fair.

No. III.*

FOR the first time in the history of the British Industries Fair an endeavour was made at the Birmingham Show, which closed on Friday, February 26th, to bring together a really representative collection of electrical goods. Something like eighty firms, including several of the largest makers engaged in the manufacture of heavy electrical machinery, were in evidence, and although it cannot be said that any of the exhibits were exceptionally notable from the standpoint of originality, taken as a whole the electrical section of the Exhibition was thoroughly good. In view of the important position which the electrical industry has attained, it is rather a pity that it has not taken a more prominent part in the previous Fairs that have been held at Birmingham, where, as everyone knows, a considerable amount of electrical manufacturing work is carried out, and where there is a very active and successful supply undertaking. It is highly probable, however, now that a real effort has been made to represent the industry at the Fair, that electrical exhibits will continue to be more conspicuous than they have been in the past, and that more firms will be willing to participate. The one object of the Fair is, of course, to promote British trade and attract overseas buyers, who presumably expect to find at Birmingham something besides hardware and similar goods. An extensive and representative display of electrical machines and apparatus at future Fairs can scarcely fail to do good, for Birmingham is essentially a manufacturing and business centre where electrical and other engineering products can be shown in a proper atmosphere.

With a view to demonstrating the value of electricity in the factory and in the home, the Birmingham Electric Supply Department had an attractive stand on which such things as electrically operated welders, furnaces, machine tools, and various domestic appliances, &c., were shown. From a technical point of view, two of the most noteworthy exhibits were a sample of Major A. M. Taylor's extra high-tension cable with intersheaths and a demonstration outfit for showing how the power factor of an electrical installation can be raised by means of a Helsby condenser. An induction motor running light was first connected to the supply system without the condenser and afterwards with the condenser across its terminals, the effect on the power factor being clearly shown on an ordinary power factor indicator. The Birmingham Corporation does not charge its consumers on the kilovolt-ampère basis, but allows a discount of 5 per cent. on the total power bill if the average power factor is ·9 or higher. In one case, we are told, the Corporation supplied a consumer with a Helsby static condenser equipment of 182 kilovolt-ampères capacity at a cost of £820, which raised the power factor of the consumer's load to ·92, with the result that the 5 per cent. discount amounted to no less than £600.

The Hewittic mercury vapour rectifier sub-station installed in the Exhibition by the Birmingham Electricity Supply Department for supplying direct current to one of the buildings was one of the principal electrical attractions. There were two banks of rectifiers arranged one behind the other, as shown in Fig. 20, and each bank, composed of four cubicles, was fed by a Hackbridge transformer, to be seen on the right of Fig. 20. The delta connected primary windings of these transformers were supplied with three-phase, 50-cycle current at a pressure of 5000 volts, and from the double star-connected secondary windings the bulbs were fed through small regulating transformers in each cubicle, the total direct-current output of the complete installation being 200 kilowatts at a pressure of 440 volts between the outers of the three-wire system. The method of working rectifiers in this manner has been fully described in our columns,* and beyond stating that two bulbs are connected in series we need not enter into further details.

Three electric trucks, including two of an entirely new design, were exhibited by Electricars, Ltd., of Landor-street, Birmingham. The small truck shown in Fig. 21 has been specially designed for the transport of goods along narrow gangways and in congested areas, where the use of a larger machine would be impossible. The capacity of the truck is 1 ton, the overall length 7ft., the width 2ft. 4in., the length of the elevating platform 3ft., the width 1ft. 6in., the height of the platform when lowered 6in., and the height of the lift 3in. As the illustration Fig. 21 shows, there are only three wheels, the driving and steering being done by the leading wheel, which is of large diameter and in which the motor is incorporated. The carcase of the motor may be considered to constitute the hub spindle around which the wheel revolves and is driven through reduction gearing by the revolving armature. Great care has been taken in the design of this truck to ensure stability. The platform can be elevated by hand by means of the long lever to be seen in the illustration, and since the platform has the same overall dimensions and height as those commonly employed on the majority of manually operated trucks, the usual stillages can be retained. As in the case of all the company's trucks, alkaline or lead batteries are provided, according to customers' requirements. The other new electric truck that was exhibited is shown in Fig. 22. The capacity of this truck is 2 tons, the overall length 9ft., the width 3ft., the length of the elevating platform 4ft. 6in., the width 2ft. 2in., the height of the platform 10½in., and the height of the lift 4in. Four-wheel steering is employed, the turning radius being 8ft. 6in. to the outer corner of the track. The design of this truck differs in several respects from that of other elevating platform trucks. Only one motor is used for propelling the vehicle and for lifting the platform. Power from this motor is transmitted through silent chains to a selective dog clutch by means of which the platform is elevated or the truck is propelled, the motor being automatically stopped when the platform has been raised or lowered to the maximum extent. By utilising one motor for propelling the truck and for raising or lowering the platform the makers have reduced electrical gear and wiring to a minimum. The truck is propelled by an overhead worm-driven axle and the power is transmitted to the driving wheels through bevel wheels mounted on and around the stub axle swivel pins, totally enclosed and running in oil. This form of construction eliminates

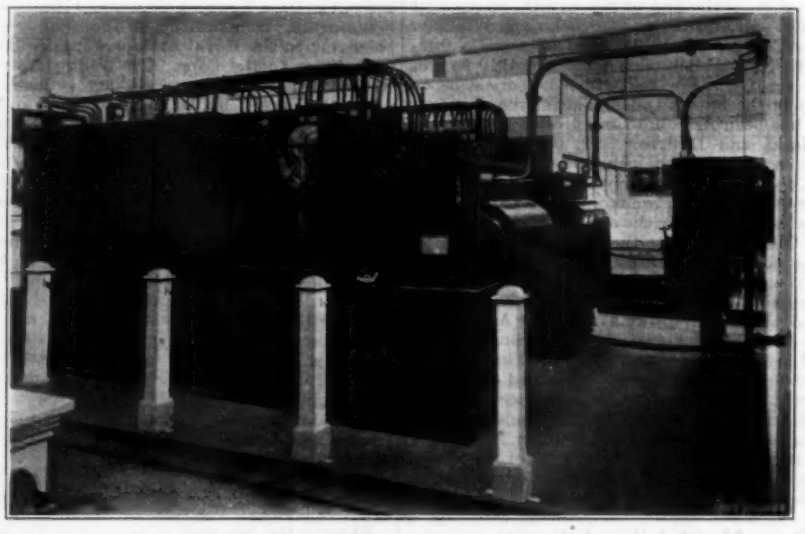


FIG. 20—MERCURY-VAPOUR RECTIFIER—HEWITTIC

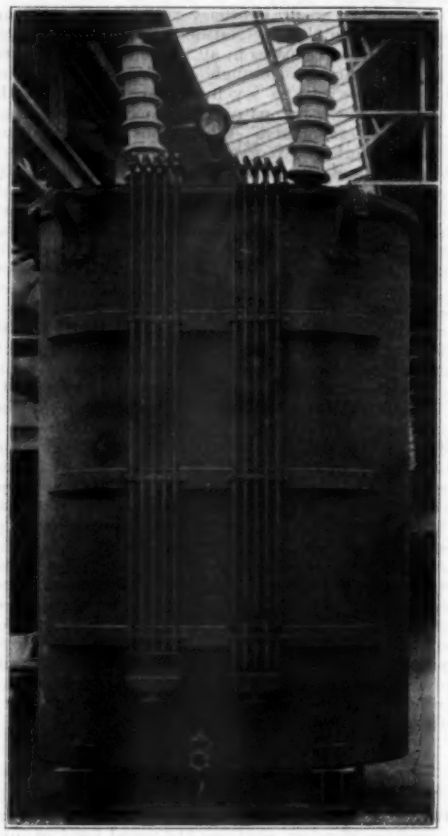


FIG. 23—110,000-VOLT TRANSFORMER—ENGLISH ELECTRIC

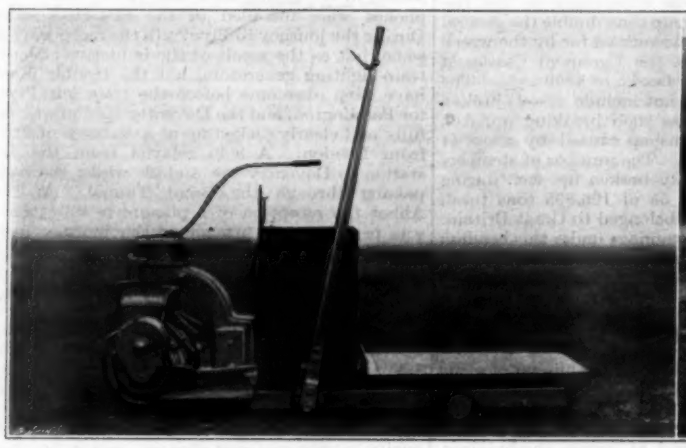


FIG. 21—ONE-TON ELEVATING PLATFORM TRUCK—ELECTRICARS, LTD.

FIG. 22—TWO-TON ELEVATING PLATFORM TRUCK—ELECTRICARS, LTD.

* No. II. appeared February 26th.

* See THE ENGINEER, July 24th and 31st, 1925.

open universal joints, which in the ordinary way are difficult to lubricate, whilst their exposure to dirt, the makers point out, results in wear and back-lash and consequent jerky starting. Another improvement is the use of a laminated spring suspension in place of the usual coil spring or springless systems. Coil springs, the makers contend, frequently give trouble as the result of breakage, but with the system that has been adopted the durability of the truck itself and of its battery should, it is considered, be materially increased.

A 110,000-volt, 50-cycle outdoor transformer case—as shown in Fig. 23—was among the exhibits of the English Electric Company, of Queen's House, Kingsway, W.C. 2, the size and weight of the transformer itself being too great to permit of it being brought to the Exhibition. The transformer is one of twelve

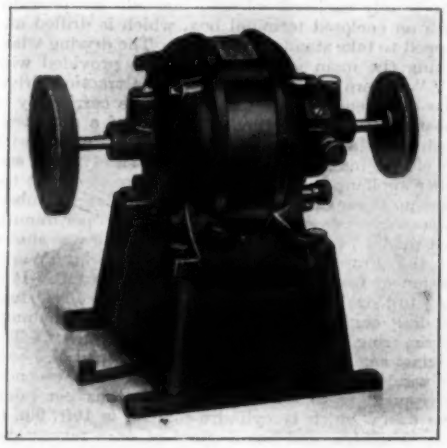


FIG. 24—ELECTRICALLY-DRIVEN POLISHING BUFF—MANDA

units recently built for a large power transmission scheme in India. Each water-cooled core-type single-phase unit has a maximum output of 12,500 kilovolt-ampères at the B.E.S.A. rating of 60 deg. Cent., as measured by resistance and corrected at the instant of shut down. They have been designed for stepping down to 23,000 volts, the high-pressure windings being connected in delta and the low-pressure windings in star. The test pressure specified was 240,000 volts between the high-pressure and low-pressure windings and core, and the whole of the high-pressure windings had to be insulated to comply with that condition. On account of their size many special features were incorporated in the design, including the provision of internal cooling ducts throughout the magnetic circuit, and the adoption of the English Electric Company's key-bolt core construction, which eliminates all vertical tie bolts. High voltage condenser bushings with porcelain shields, give the neces-

FIG. 25—OIL-BREAK STAR-DELTA MOTOR STARTER—ELLISON

sary creepage distance under wet conditions, and the makers tell us that they will easily withstand 350,000 volts when dry and 250,000 volts under wet conditions, without flashing over.

A collection of small motors varying in size from one-twentieth to ½ horse-power, with series, shunt and compound field windings, was shown by Manda Motors Ltd., of 53-54, Royal Mint-st., London, E.1. The speeds for which these motors are designed vary from 1000 to 2500 revolutions per minute. Induction motors of similar output are also made for single and poly-phase circuits. For charging high voltage accumulators for wireless purposes the company has developed a small motor generator set, which gives 70 volts on the direct-current side and a current of ½ ampère. The problem of charging high-tension wireless accumulators is one with which many people are now faced, and a machine of this character should meet with appreciation, especially in places where only alternating current is available. There were also electrically-driven exhaust fans with box and horn blades of different sizes, designed for direct-current and alternating-current circuits, buffing, polishing and grinding motors, as shown in Fig. 24—and starting and regulating switches for use with the company's machines.

The oil-break star-delta motor starter—shown in Fig. 25—was one of the exhibits of George Ellison,

FIG. 26—OIL CIRCUIT BREAKER—ELLISON

of Perry Bar, Birmingham. The starter is suitable for line currents up to 30 ampères at a three-phase pressure of 660 volts. A correct sequency device ensures that the operator first puts the handle in the star position and then quickly changes over to the running position. Adjustable time lags are fitted to the overload releases, and they are protected by a cast iron cover, which may be padlocked. If desired a moving iron ammeter may be mounted on the starter cover, which is locked when the starter handle is in the running position, the ammeter being connected in circuit by spring clip contacts, engaging with the terminals. The Ellison oil circuit breaker—shown in Fig. 26—which was also exhibited, has been designed to meet the demand for a breaker of small current capacity and high circuit interrupting capacity. It is fitted with the usual automatic releases and interlocks, and is built on the same general lines as the firm's larger circuit breaker; the terminals being mounted on a sheet of reinforced synthetic resin, which has a high insulation resistance. Controller-pattern fixed contacts are used, whilst the moving contacts consist of copper bridges carried on a cross bar of reinforced synthetic resin, moving vertically on steel guide rods. There are two breaks per phase, each ¼in. long, and as they are made under a 3in. head, the breaking capacity is exceptionally large. Provision is made for an ammeter to be plugged into the contacts under the cover, which is interlocked with the handle. The overload and no-volt trip coils and the time lags are of the same size as those on the larger circuit breakers, and the adjustment tubes are enclosed in dust and water-tight covers, which may be padlocked. The 6600-volt control panel for a slip ring induction motor—see Fig. 27—was another of George Ellison exhibits. The oil-break stator switch with an ammeter mounted on the front of the case, and fitted with the usual protective devices, is to be seen on the right, and the rotor resistance on the left.

The Pirelli General Cable Works, Ltd., a branch of the General Electric Company, was showing the new Pirelli joint for high-pressure cables, such as 33,000-volt cables. With the difficulties that arise in high-pressure joint making we need not deal. It must suffice to say that the Pirelli joint is claimed to obviate loose tubes, to give tight fitting insulation on the cores, to preclude the possibility of air spaces, and that the insulating material used is exactly the same as that of the cable. The principle involved will be understood from Figs. 28 to 30, where A represents a cable core on which it is required to place a tight-fitting paper tube. On rotating the roll of paper in the direction of the arrow, the core A is transferred in a manner described in detail below, from the outside of the roll to the centre—in accordance with Figs. 29 and 30—and if one end of the paper be fixed to the core—as shown at D—further rotation of the paper in the same direction will tighten up the roll, the only part of the paper that has to be handled by the jointer in the whole of these operations being the outer length B C. The Pirelli patented paper tubes are designed to take advantage of these principles. The tubes are made from the same kind of paper as that used for the cable core insulation, and they are cut on the taper, rolled into tubes, dried, impregnated, and sent out in compound in sealed tins.

The method of placing the tubes in position can best be seen from the illustrations—Figs. 31 to 33. A short length of paper is uncoiled from the roll, which has previously been heated, slipped through the space between the cores and brought back to the roll again in the form of a loop; the length corresponds to the

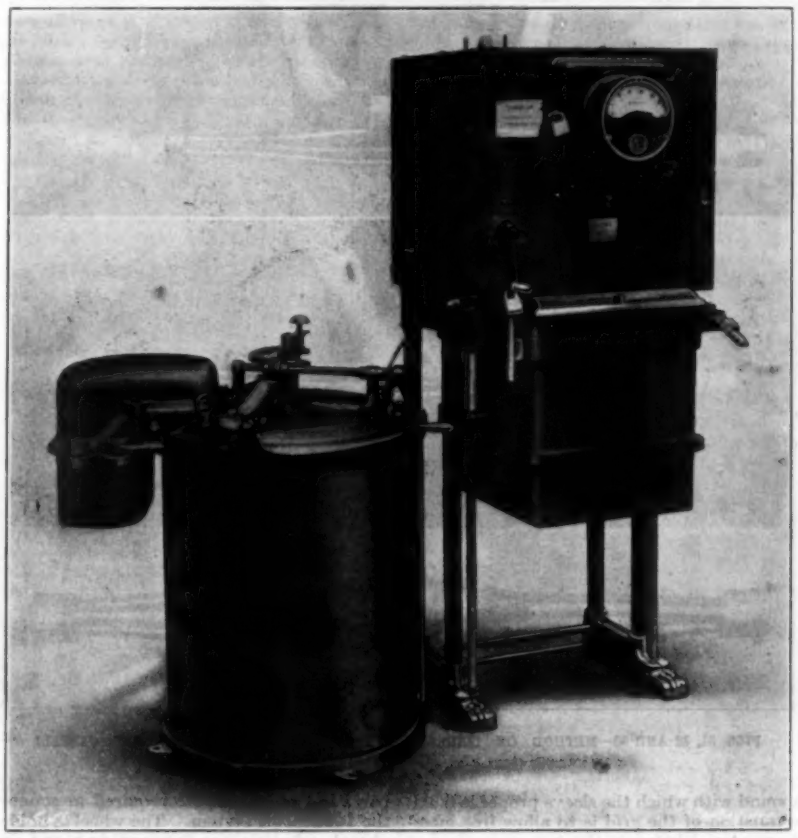
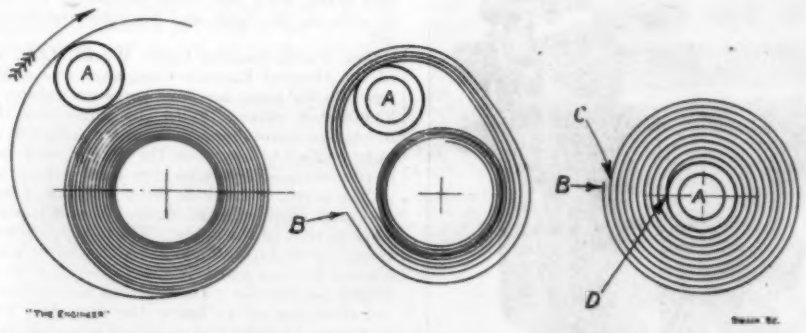


FIG. 27—6600-VOLT STARTING GEAR FOR SLIP-RING MOTOR—ELLISON

length B C of Fig. 30. If the roll be then turned in the proper direction—as indicated in Fig. 31—the roll will unwind, and the loop, instead of being formed with a single thickness of paper, will gradually increase until the whole of the roll is unwound and takes up its position round the core. On the ends of the inner layer of paper, adjacent to the core, there are two small tags, their function being to enable the jointer's mate to hold the inner layer of paper firmly, whilst the final operation of tightening up the roll

is carried out, or alternatively the tags may be secured to the core by means of a length of twine. After tightening has proceeded as far as possible, with bare hands, the jointer takes a strip of clean glass paper, and employing it to obtain a better grip on the roll, proceeds with the tightening operation until no more tightening is possible. When that stage is reached, all the interior air will have been squeezed out, together with all superfluous oil, and a solid tube of paper will be left round the jointed conductor, which will not unroll even when the pressure is removed. The outer layer of paper,—the only layer of paper that has been handled by the jointer—is then removed, leaving a solid tube of impregnated paper. After the three cores, of a three-core cable, have been



FIGS. 28, 29 AND 30—METHOD OF APPLYING PAPER INSULATION TO HIGH-PRESSURE CABLE JOINT—PIRELLI

treated in this manner, they are bound round with an additional narrow layer of paper in exactly a similar way, thus holding the three cores in position—as shown in Fig. 33. The Pirelli paper tube joint is equally suitable for sector cables by making use of a principle which is easily understood.

The new sleeve incorporating a reservoir is claimed to offer great technical advantages over the usual type. It is strongly recommended for any voltages, and it is invariably used for voltages of 22,000 and upwards. The upper part of this sleeve is in the form of a perforated grid. Over the grid, enclosing it, is a domed compartment, having the normal filling holes used in jointing sleeves. The function of the top compartment is to hold a reserve supply of the oil or compound with which the sleeve proper is filled, whilst the function of the grid is to allow free interchange of compound between the top reservoir and the sleeve proper, but without interrupting the continuity of the sleeve, which is thus unaffected electrically, by the presence of the reservoir. It follows that the compound and the air space are not under stress, and the joint is unaffected by any rise or fall of compound, which may be caused by expansion or contraction of the cable or joint during operation. The box is, of course, designed to accommodate the special sleeve.

Another interesting feature of this joint is the type of socket or ferrule used for joining the conductors of 22,000-volt cables and upwards. It is of the sweated type and made with separate end pieces, each tapered at one extremity and recessed at the other. The tapered ends fit into the core insulation, which is undercut to the correct dimensions with a special tool provided for the purpose. The recessed ends are made to accommodate the ends of the centre part of the socket. This centre part is split along its length forming two half sections of a cylinder, so that it will exactly enclose the conductors. It is therefore unnecessary to move the conductors apart in order to insert the socket. Perfect alignment having been obtained the two half sections of the socket are placed around the conductors and fitted into the end pieces, ready for sweating. The overall diameter of the completed socket is exactly equal to that of the core insulation, so that, as the surface of the socket is perfectly level with the core insulation, there is no space whatever in which air can remain. The cores having been straightened out over a sufficient length, and the socket having been sweated, there remains a smooth cylindrical surface on which the paper tube is wound. Fig. 34 shows socket with one end piece removed.

The large electric lift gear—which is illustrated in Fig. 35—was shown by the General Electric Company. The normal rating of the gear is 40 horse-power, but the actual torque that may be transmitted during starting and stopping may greatly exceed that corresponding to the normal output of the motor. The method of driving the gear, the makers point out, gives a low centre of gravity for the heavy revolving part, and no glands are required in connection with the lubricating system. The wheel is hobbed from a phosphor bronze rim fastened to a cast iron spider, the metal of which the wheel is made having been carefully selected with a view to securing a hard tooth combined with sufficient resilience to stand up to the rapidly fluctuating loads. The end thrust is taken by a Hoffmann ball thrust bearing, specially designed to deal with the load carried at the rather high speed of the worm shaft. The gear-box forms an oil bath for the worm wheel. The motor, which is controlled by a special controller, is said to give smooth and rapid acceleration and deceleration, and an accurate levelling at the floors. Two separate and independent brake mechanisms are used, each having two brake bands acting on the coupling, which forms the brake drum. Each brake is of the electro-magnetic type. A magnetic solenoid removes the bands from the coupling, so that when the current is switched off, or in the event of it failing, both the brakes are applied to the coupling. As the brakes are connected in independent circuits, a fault on one circuit will not affect the other brake. It is essential that the brake system should be absolutely infallible, for, owing to the high speed for which the lift is designed, the worm gear is not entirely self-sustaining. If for any mechanical reason one hand brake fails to reach the coupling, when it is applied, the other brake will exert its own braking force independently of the faulty brake. It is possible to adjust the brakes so that there is equal clearances at the couplings, and a magnetic adjustment is provided on the solenoid in order that a suitable stroke may be arranged for under any conditions of wear in the bands. The totally enclosed solenoid magnets are provided with an enclosed terminal box, which is drilled and tapped to take standard conduits. The driving wheel taking the main ropes of the lift is provided with "V"-pattern grooves, arranged for traction drive. The outer end of the driving shaft is carried by a substantial outer bearing, consisting of a gun-metal bush in a heavy cast iron housing. Together with its electro-magnetic controller, car, safety gear and other appliances, the gear is claimed to represent the most up-to-date product for dealing with large numbers of passengers at speeds of 300ft. to 350ft. per minute.

A model of an electric winding engine was shown on the Fraser and Chalmers Engineering Works section of General Electric Company's stand. It is an $\frac{1}{8}$ full size working model of an electrically-driven winding engine supplied by Fraser and Chalmers Engineering Works to a South Wales colliery. The original engine was designed for a coal load of 5 tons per wind from a depth 1500ft. in a period of 58 seconds, corresponding to an output of 250 tons per hour. The drum, which is cylindro-conical, is 10ft. 9in. to 16ft. diameter, and has a speed of 40·8 revolutions per minute. The motor is an alternating-current machine, rated at 1100 brake horse-power, at a speed of 230 revolutions per minute, and it transmits its power to the drum through single reduction gears having double helical teeth and a ratio of 5·65 : 1.

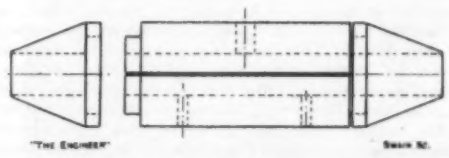
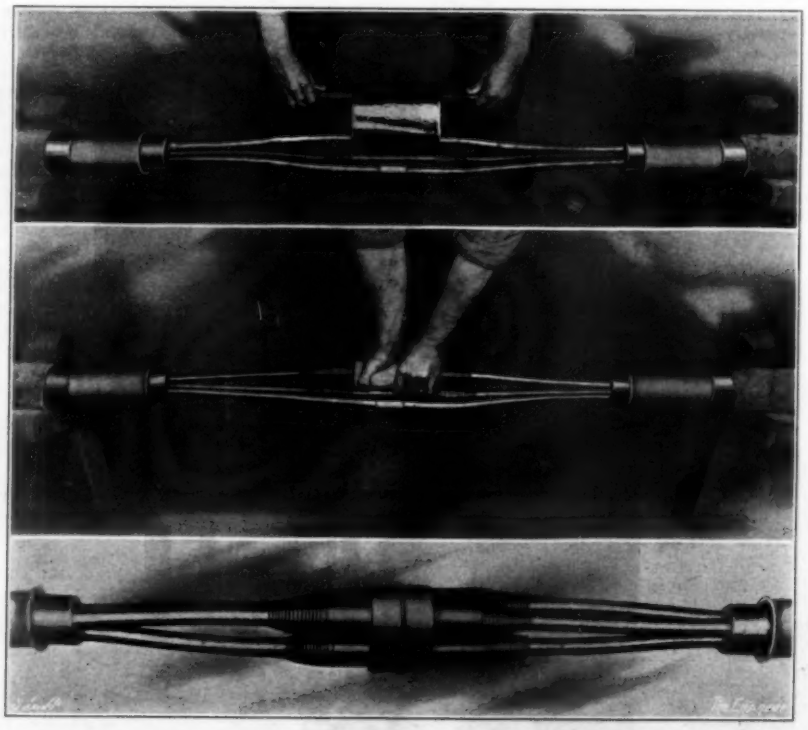


FIG. 34—FERRULE FOR HIGH-PRESSURE JOINT—PIRELLI



FIGS. 31, 32 AND 33—METHOD OF INSULATING HIGH-PRESSURE CABLE JOINT—PIRELLI

In the model—see Fig. 36—the general external appearance of the complete winding equipment has been faithfully reproduced. The drum is made to rotate by means of a fractional horse-power motor situated in the base of the model. It is connected by a belt to a pulley inside the winder motor, and transmits its power through the gears to the drum. An arrangement is provided in the control cabin for reversing if required. The drum, a very important part of the equipment, has been carefully reproduced in cast iron to correct dimensions. Auxiliary equipment, such as the Whitmore overwinder, brake engine and take-up gear, switch cubicles and drivers, is reproduced in dummy form and does not operate.

The steel works motor shown in Fig. 37 was another of the General Electric Company's exhibits. For the operation of live roll gear and other auxiliaries in steel works motors, of great mechanical strength are required, but the rotating parts must have small inertia, because of the need for rapid acceleration, retardation and reversal. The motors should also be totally enclosed so as to exclude dust, whilst at the same time it is important that the construction should allow of rapid dismantling and inspection. The requirements are more easily met in the case of alternating-current machines than they are in the case of direct-current motors, but the General Electric Company has designed steel mill motors for operating with both kinds of current. The direct-current machines—as shown in Fig. 37—are totally enclosed and series wound, the carcase being of very robust construction. The frame, it will be noted, is in two parts, which are bolted together along the axis, whilst the bottom half is provided with strong feet at each corner so that the machine may be bolted to the floor. At both ends of the armature the shaft is extended so that the drive may be taken from either end, the opposite end of the shaft being utilised, if necessary, for a solenoid brake. The main pole pieces are composed of laminations secured by rivets, and the main and commutating poles are wound with copper strip on edge, insulated with mica between the turns and mounted on mica spools. In order that the armature may have low inertia the diameter is made small, and its spider is extended to carry the commutator spider. The armature and commutator therefore form a complete unit independent of the shaft, which can easily be removed. The commutator lugs are in one piece with the bar, thus rendering soldering unnecessary. For preliminary inspection purposes the carcase is fitted with large doors, but, if it should be necessary to dismantle the motor, the

work can be carried out in a very short space of time. As shown in the illustration, the top half of the case is provided with special lugs, and on the removal of two terminal links and the bolts which hold the two parts of the frame together, the top half of the case can be lifted. To the bearing bushes in which the armature runs eye-bolts are permanently secured, and when the top half of the carcase has been raised these eye-bolts enable the armature to be lifted from the botton half of the carcase. As the brush gear and armature leads are entirely fixed to the top half of the case and come away with it, no time is taken up in dismantling them. At the joint of the horizontal split magnet frame there is a special terminal box for the field connections, and the terminals are arranged so that, when the top half of the magnet frame is to be raised, the removal of the two links mentioned disconnects the two parts of the motor field from each other and interference with internal connections is unnecessary. The box type of brush gear is used, and as the armature is wave-wound, only two brush spindles are required. The motors are capble of withstanding heavy overloads, and have a starting torque equal to 2·5 times the normal torque.

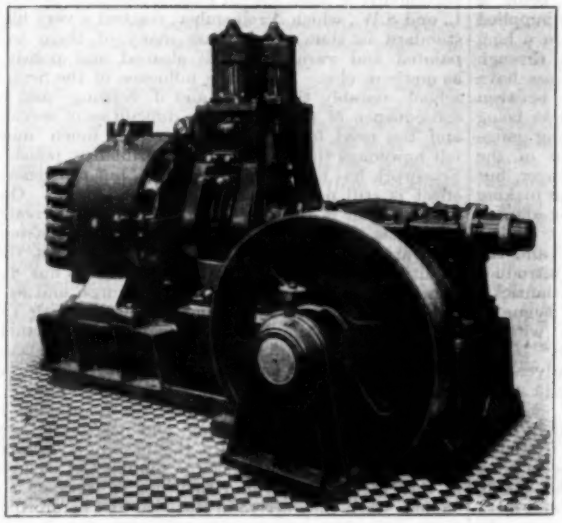


FIG. 35—ELECTRIC LIFT GEAR—GENERAL ELECTRIC

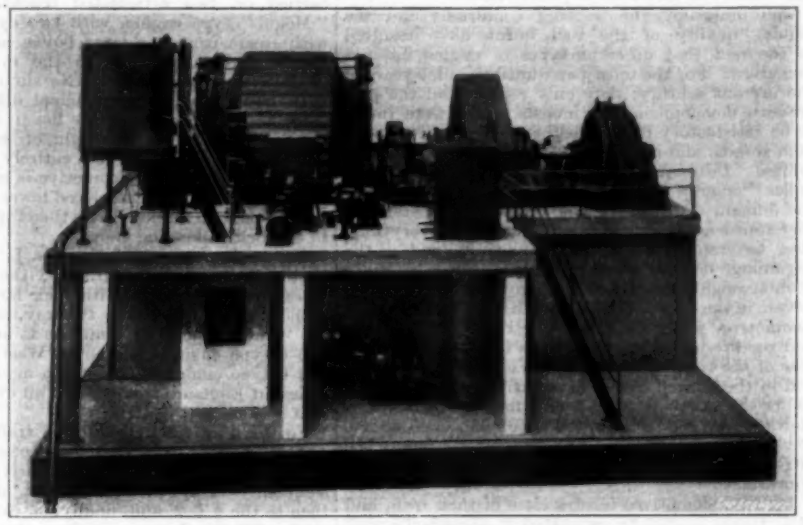


FIG. 36—MODEL OF ELECTRIC WINDING ENGINE—FRASER AND CHALMERS

In conjunction with the Austin Lighting Company, of Banbury, the National Gas Engine Company, of Ashton, was showing, among other things, an interesting automatic engine-driven sub-station plant, consisting of a 10½ horse-power vertical single-cylinder gas engine driving a 6-kilowatt dynamo, with a 30-volt electric motor attached to one end of the shaft, as shown in Fig. 38. This motor, which is designed to carry a heavy overload for short periods, was supplied with current during the starting periods by a traction type D.P. Kathanode battery as used in one of the Railodock cars at Wembley. The plant was controlled by one of the Austin Company's automatic switchboards. The stand was illuminated by a number of high-power lamps supplied by another set, which represented a central station, and as soon as a little over half the total number of lamps were switched on the automatic control gear came into operation and connected the starting battery to the 30-volt motor attached to the dynamo of the vertical gas engine, which was consequently set into motion. The gas having also been automatically turned on, the set then commenced to generate, and when the full voltage was reached the set was automatically connected in parallel with the other set, which represented the central station. As soon as the load dropped to a predetermined value, as a result of some of the lamps being switched off, the automatic gear worked in the reverse order, the gas being cut off, the circuit and filling up purposes. The automatic switchgear used in conjunction with these self-starting sets is interesting. In the demand instrument which controls the operation there is a strip of bi-metallic metal coiled in the form of a spring. The effect of the passage of current through the strip is to make the spiral uncoil itself until a silver rod attached to the end comes into contact with another similar rod at right angles. That causes a current to be sent through a relay to a small reversible motor, operating a sliding switch, that first switches on the current to the starting motor through resistances, which are gradually cut out of circuit, and at an appropriate moment makes an auxiliary contact and the gas is turned on by means of a solenoid operated tap. When the plant is running the motor is used to re-charge the starting battery, and if it is full before the plant shuts down, as is usually the case, a small relay inserts a resistance in the circuit, thus cutting down the charging current practically to nothing. The sub-station plant would always work at about full load, any surplus current passing back towards the central station.

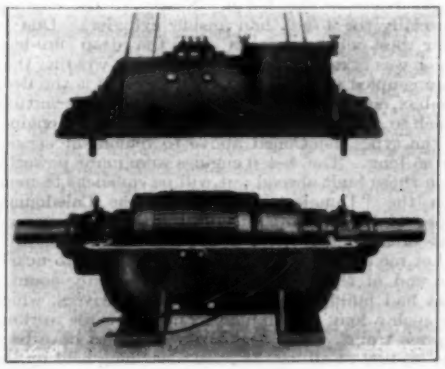


FIG. 37—STEEL WORKS MOTOR—GENERAL ELECTRIC

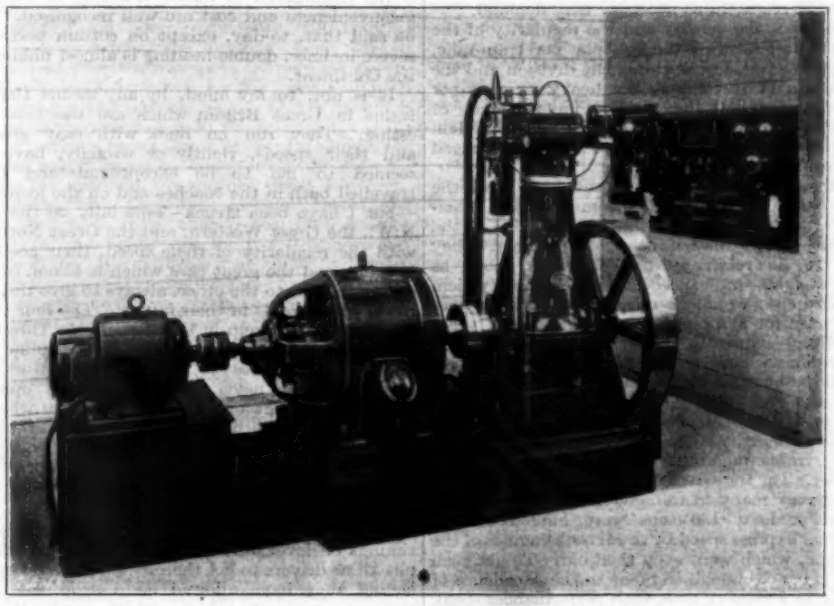


FIG. 38—AUTOMATIC SUB-STATION PLANT—AUSTIN-NATIONAL

Visitors to the Fair who are using, or who are contemplating using, electric power had a good opportunity of studying the merits of different makes of electric motors and of comparing prices. A firm that took particular pains to demonstrate how its motors being opened, and the engine being brought to a standstill.

The object of the exhibit was to demonstrate how an automatic direct-current sub-station plant of this character might be used to feed into a system at an outlying point where a load has to be met and to which it would not pay to run a special feeder from the main station. Although at the Exhibition the plant was run on town gas, the scheme is also applicable when the fuel consists of crude oil, in which case the makers claim the running costs would be very low. A visit of about half-an-hour per day is said to be all that would be required for cleaning, oiling, and filling up purposes.

are constructed was Higgs Motors, Ltd., of Witton, Birmingham. In addition to showing complete motors in operation, the firm exhibited component parts and demonstrated manufacturing processes, including induction motor, stator winding, which was carried out on the stand. Veritys, Ltd., of Plume-street, Aston, Birmingham, also had a good display of motors for direct current and alternating current. B.K.B. Electric Motors, Ltd., of Hay Mills, Birmingham, was showing, among other things, a single-phase motor which starts up as a repulsion machine, and afterwards converts itself automatically into an induction motor with a short-circuited rotor winding. Motors of this kind are not, of course, by any means new, but hitherto they have been built mainly by foreign firms. W. E. Burnand and Co., of Duo Works, Sheffield, was another firm that was showing motors, notably induction motors without slip rings, but capable of developing a high starting torque and of working with a good efficiency. The electric welding branch of the electrical industry was, of course, represented. Spot, butt and seam welders were shown, and one of the principal firms exhibiting welding appliances was Allen, Liversidge, Ltd., of Victoria Station House, S.W. 1.

W. Canning and Co., Ltd., of Great Hampton-street, Birmingham, showed many things of interest to those who are engaged in electro-plating work, including a plating apparatus in which the work travels on an endless chain through the solution. There was also apparatus for filtering and electrically heating solutions, lacquer spraying apparatus, low-voltage plating dynamos, and motor generators, &c.

An example of rapid work in the way of concrete construction is the completion of two silos, 32ft. in diameter by about 140ft. high, with walls 8in. thick, in Cuba. The two silos, together with two connecting walls, were completely poured in five days.

Notes on British Railways by a Continental Engineer.

No. V.*

Locomotives.

The question of locomotives would require a long treatise all to itself, and I shall therefore limit my remarks to some of the most striking characteristics of British engines, and to those features which can be compared with those of foreign design. The British locomotive, it can be said at once, adds a completing touch to the train to which it is attached that cannot be met with anywhere else.

The uniformity of working conditions and the regular quality of the fuel burnt have resulted in the fact that different types of engine are not numerous. For the most part, until the first years of the present century, they only represented the progressive developments of models which were found to be satisfactory in the early stages of railways for high speeds, and in which overhang has been strictly limited. I do not, of course, include the early "long boiler" engines of Stephenson which now belong to the domain of history. The English designers have therefore confined their attention, before everything else, to stability in their locomotives, and at the beginning, on the contrary, they seemed to study counterweights less rationally. Anyhow, I have looked in vain in the whole of the United Kingdom for a single locomotive, either on a main or branch line, which had the fire-box taken back so as to overhang to the rear of the trailing axle, whereas on the Continent—and in the United States in shunting engines—many can be seen, though they are only used for slow trains and in goods service. At the time mentioned above, the "Atlantics" and the "Ten-wheelers"—before the introduction of more powerful engines—made their appearance.

British locomotives form a class of their own, and their power cannot be estimated in accordance with the same units of measurement, as in other countries, or by a simple comparison of their dimensions, for the excellent quality of the coal which they burn, the manner in which they burn it, so that the combustion and the production of steam can be more active, make them more powerful, per unit of grate area and adhesive weight, than the other European engines in which economy of fuel is more important.

The British companies, which are private and industrial undertakings, are little subjected to abrupt changes or to the trial of new arrangements which have not proved their value in service or which differ too radically from ordinary practice. They only depart from their accustomed routine for pressing reasons, and when the results of that departure are certain. This spirit of conservatism indicates a steadiness of idea and a belief in convictions which are all the more interesting in that they are not accompanied, far from it, by a lack of desire to invent or to carry out research, as necessity may demand.

For the rest, the density and the regularity of the traffic, the largeness of the receipts per train-mile, the general methods of working, the division and the specialisation of the trains, the heavy weights per axle permissible, and the relative independence of the companies, eliminate in the United Kingdom many difficulties which are or have been experienced elsewhere.

English engineers have for long sought to reach the ideal of obtaining from their locomotives the maximum of work per unit of weight, and thanks to the good coal—which they have ready at hand—they manage to do relatively difficult work, both as regards weight and speed, with engines which, everywhere else, would be relegated to branch lines or used only for stopping trains. It is many years since a train—express or non-stopping—has left the Paris termini without having at its head a locomotive having three coupled driving axles. Now, in Great Britain one can still see locomotives—with large boilers, it is true—of the 4–4–0 type, hauling for 150 miles at least, without stop, on lines with easy gradients, trains weighing from 350 to 400 tons behind the tender. On the Great Western, in particular, it is not so very many years ago, that ultra-suburban trains of at least 180 tons were hauled on the main line at express speed by small tank engines of the 2–4–0 type, which were even then old. To get such a result it is not enough to point to the excellence of the fuel; to a railway man, such performances speak volumes, and show the high standard of excellence which has been insisted upon by successive locomotive superintendents. It is not that the engines could not be kept in as good repair abroad, but, there, engines are often allowed to run too great a mileage between repairs; and too many miles run before a locomotive is sent into the shops for overhaul, may appear to show an economy, whereas in reality it often means the contrary.

But the tendency, to which I referred above, to crystallise old models, is in course of becoming a thing of the past, for an important move is being made in the direction of employing much more powerful engines for all classes of service. Many lines have already started to replace, for goods trains, the 0–6–0 engine—after making it as powerful as possible—by the "Mogul" type of locomotive—then by the 2–8–0—as, for instance, the L. and N.W., the Great Western, the London and North-Eastern, and several others, often employing three cylinders, one of them between the frames. The last-named line has even just built for pushing coal trains a tank engine of the Garratt articulated type, simple expansion, and weighing 180 tons in working order. It is one of the most powerful engines which has been put into service in Europe during the past few years.

Locomotives of the Garratt type are, of course, no novelties. In 1905 the Northern Railway of France and the Paris Belt line ordered for heavy goods traffic several powerful tank engines to the designs of M. du Bousquet. These locomotives were carried on two articulated trucks, each being a "Mogul" type engine, with two cylinders supplied with steam from one large boiler carried on a long frame. Steam was led to the cylinders through flexible, articulated pipes. No similar engines have been built since. The principal difference between them and the Garratt engine lies in the trucks being not far apart, since the height of the loading gauge allowed the boiler to be entirely on top of the trucks. The Garratt locomotive is much longer, but it allows the boiler to be placed lower without making the fire-box too shallow; it is therefore better adapted to the British loading gauge.

For their passenger trains the L. and Y and the Great Northern were the first, I think, to introduce more powerful engines with their large "Atlantics"—the Great Northern, by the way, has now begun to use "Pacifics." Then came the L. and S.W. with its 4–6–0 type engines, the Great Western, &c. If the 4–6–0 type engine is not at the moment universally in use in England, there are at all events indications that it soon will be.

For locomotives for suburban traffic, British locomotive engines have passed, successively, from the classic 4–4–0 engines, with the driving wheels most frequently arranged in front, to, first, the 4–6–0, then to the 4–6–2, and, finally, on the L.M. and S.R., to the "Baltic" type, weighing about 100 tons. In France for the latest engines, the type chosen—I think rightly—is the "Mikado"—2–8–2, which for a minimum of length, offers an arrangement of coupled axles that is particularly suitable for locomotives that are called upon to stop and start frequently.

There has been exhibited, as regards locomotives, a fact quite opposite to that which I have pointed out in connection with the outstanding progress of English railways. The English entered the epoch of large engines fifteen years later than did the Continent. But, once again, I can but see in their action a desire to proceed only as fast as necessity called for it, and then, too, the ever-present questions of the good quality and comparatively cheap price of the coal, with regard to which both England and Scotland are so fortunately placed, must not be lost sight of.

One of the advantages of powerful locomotives is the elimination of double-heading, of which the inconveniences and cost are well recognised. It can be said that, to-day, except on certain particularly severe inclines, double-heading is almost unknown on the Continent.

It is not, to my mind, by any means the crack trains in Great Britain which are the most interesting. They run on lines with easy gradients, and their speeds, rightly or wrongly, have never seemed to me to be exceptional—and I have travelled both in the coaches and on the locomotives—but I have been struck—especially on the L. and N.W., the Great Western, and the Great Northern—with the regularity of their speed, their good time-keeping, and the great care which is taken, from one end of the line to the other, always to give them clear roads with signals in their favour. The four running roads, of course, help in that direction. Throughout, the systems are orderly and perfect discipline reigns, and that conduces to general good working; a station master never allows shunting operations to be carried out on main lines at times when they would interfere with the general service of the line, of which there are, unfortunately, some examples on the Continent. The regularity of the express trains in England is largely due to the fact that they seldom find the signals against them.

While I fully realise the difficulties in observing timings on level lines with stops far apart which do not allow drivers to get their steam pressure up again should they have allowed it to drop, one of the services, amongst others, which made the most impression on me, not so very many years ago, was that on the Glasgow and S.W. between Carlisle and Glasgow, which was effected at that time with engines of the 4–4–0 type and of quite moderate dimensions. These engines during the whole of the journey, including the inclines, always maintained a full head of steam, and their speed was always regular and high despite the arduous nature of the road. I have always remembered that trip as a truly remarkable performance. I noticed that the Scotch drivers notch-up their gear even less than do their English colleagues and press their engines to the utmost. Having regard to the relatively low price of the fuel used, that is not to be found fault with; on the contrary, I was delighted to observe the endeavours to get the best possible effort out of the engine, while the rapidity of getting away from the stations has something stimulating in it which is most pleasing, and shows that the drivers are not hampered by thoughts of the necessity to economise fuel because of its high cost.

English engineers have always paid a great deal of attention to the appearance of their engines, with the object of combining simplicity and symmetry with well-balanced proportions; in a word, to make them reach a high æsthetic standard on all the lines. Their success in this direction has certainly had a good deal to do with the interest which both the public and the railwaymen themselves take in railway matters, that used to be so striking. The locomotives of to-day, though the engines on some lines may not be quite as handsomely finished as formerly—I have particularly in mind the old Beattie locomotives of the L. and S.W., which, I remember, reached a very high standard in that respect—are many of them well painted and varnished, well cleaned and polished as nowhere else. Under the influence of the Scotch school—notably that of P. and J. Stirling—and in consequence of the increasing difficulties of service, and the need for economy which is much more felt nowadays than it used to be, brilliantly polished brasswork has been done away with, but the general effect is still neat and to some extent *doric*. One recognises in it the outcome of the friendly rivalry which has, for such a long time now, existed between the various companies. I sincerely hope that this tradition, which is essentially British, will not disappear in face of the new order of things, and as a consequence of economic considerations which rob the railways on the continental side of the Channel of so much of their prestige. Already the classic British locomotive has become, in the new large-boiler types, squat and thick-set in appearance.

Generally speaking, the engines are maintained in an excellent state of repair, and they are kept remarkably clean, especially the passenger locomotives. There are, usually, large numbers of cleaners in the running sheds, and they get to work on the engines when they arrive in the shed and before they have got cold, which greatly facilitates the cleaning process. The driver and fireman, when they report for duty, find their engines thoroughly cleaned down and almost ready for service. On certain lines the goods and shunting locomotives, worked by several crews in succession without going back to the sheds, are much less carefully cleaned and looked after.

Great Britain has, speaking generally, remained faithful to large-diameter wheels for express passenger engines, from 8ft. for the old single drivers to 7ft. or 6ft. 8in. for four-coupled or six-coupled locomotives. It has been the same in France, except that, following the example of the Americans, and on account of the increasing weights of some of the express engines, some of the lines tried wheels of some 5ft. 10in. to 6ft. diameter; but there has been a general reversion to wheels of 6ft. 6in. or 6ft. 7in. diameter, in view of the fatigue of the mechanism and the risk of heating entailed by the use of the small wheels. The same thing has also been done in America, the diameters of the wheels being increased with the speeds.

But a few years ago the types of locomotives used on the English lines were few in number; in fact, for express and passenger service there were only the single driver or the 4–4–0. Nearly all the engines, especially the 4–4–0, had inside cylinders. One of their best characteristics was the deep fire-box, which was taken between the rear axles, whether they were coupled or not. As I shall show, it is the deep fire-box, coupled with the high axle weights permitted, which to a great extent allowed of the British engines of the types mentioned above to remain in service for so long. The 4–4–0 engines were more powerful than those built abroad; it will be sufficient to mention the "Dunalastair" class of the Caledonian, those of the North-Eastern, and the "Precursor" class of the L. and N.W.

Let me add, too, that Great Britain, up to nearly the end of the last century, was the only country that had built really powerful single drivers, which for such a long time remained in favour for working express trains. This peculiarity seems to have been due (*a*) first of all, to the fixed ideas long held by the locomotive superintendents of the period; (*b*) to the comparatively small weight of the trains; (*c*) to the heavy axle loads, running up to 19 tons, permitted; (*d*) to the judicious use of the steam sander; and (*e*) to the success achieved by the large single drivers of P. Stirling on the Great Northern subsequent to 1870. But they had eventually to give way to 4–4–0 engines with inside cylinders, which were sufficiently powerful to do the work required of them until a few years ago, whereas, on the Continent, they were discarded in favour of the 4–6–0 type at the beginning of the present century.

It is indeed surprising to see, in the large English stations, engines of the 4–4–0 type starting heavy trains with apparently remarkable ease, and the English drivers know how to make good use of the steam or air sander, and they do not notch up too soon.

A little later the 4–6–0 type came more into use—the Great Western, the Glasgow and South-Western, &c.—as did also the "Atlantic" type—Great Northern, Lancashire and Yorkshire, Great Central, &c.—this last type allowing of a greater development of the fire-box, at the same time providing a sufficient

* No. IV. appeared February 26th.

depth of the latter. More recently still, as I have already said, there has been a marked tendency to build even more powerful engines.

To the credit of the British locomotive superintendents, it must be said that they have striven hard to avoid complication in their engines, and have preferred robustness, and long periods between visits to the works for repairs and overhaul, to a rather problematic economy in fuel and to certain refinements. The State lines and some other lines in France have followed the same course for certain new types—"Consolidation" and "Mikado"—but the express engines are still the four-cylinder compounds. With regard to some of the engines, the performances of which is exceedingly good, that are in service on a certain line in the south-east, it may be said that the complication of their mechanism is the outcome of ideas which are entirely foreign to British mentality.

English engineers and Locomotive Superintendents have never wasted time or money on trials of devices which have not been sufficiently tested; they are practical before all, and if they have sometimes been looked upon as being conservative, they have never been averse from progress, far from it, and they have generally progressed in proportion to the needs of the times, proceeding pace by pace—"*Natura non facit saltus*"—and they have never made gross errors or been behindhand. I can offer examples:—They developed the power of the 4–4–0 engine to the furthest limit possible before they considered it necessary to adopt the 4–6–0, the 4–4–2 and, finally, the 4–6–2, and, for goods traffic, the 2–8–0 engines. They are, in fact, very willing to progress, if they are satisfied that it is practical progress; the best proof lies in the fact that the British railways have been ahead for so long.

In the same way, English engineers, generally speaking, have remained faithful to two equal-diameter simple expansion cylinders. Recently, however, for powerful locomotives, certain lines have built four-cylinder simple expansion engines, which have the advantage of an even balancing, but are not particularly economical, especially with superheated steam, the four piston valves being liable to leakages of steam which may become considerable, unless they are very carefully looked after. The use of three cylinders, adopted on several British lines for their latest types of engines, seems preferable as presenting valuable advantages and a rational arrangement.

The Belpaire fire-box has been more or less definitely adopted by several lines as their standard practice. It seems to be less well suited to British than to foreign lines, because the restricted running gauge limits the width of the cabs, and the look-out is more interfered with than it is with cylindrical fire-boxes. It may be remarked, in passing, that on the Continent as the power and the bulk of the engines increases the Belpaire fire-box is losing favour.

While I am on this subject, it may be of interest to mention a type of fire-box which has been introduced by the Société Alsacienne de Constructions Mécaniques—and has been adopted by the P.O. Company and by the State lines in France for their "Pacific" engines. The wide American fire-box, arranged right behind the rearmost coupled wheels, has the disadvantage that it increases the length of the engine and of the boiler. The fire-box to which I am referring is of trapezoidal shape in the horizontal plan, the fore part being taken between the rear wheels and the rear portion being increased in width to the desired dimension. In consequence of this arrangement, which has proved its serviceability in twelve years of service, the "Pacific" engines of the two lines named are very compact. For the various British lines which are contemplating the use of "Pacifics" this information may possibly be of value.

The English companies have always been unwilling to adopt compounding, which they have regarded it as introducing a complication that they do not consider as producing an equivalent advantage. But they are employing superheat for all their new and rebuilt engines.

The ease with which the interior mechanism of the British engines can be got at is remarkable, thanks to the general design and to the height of the boiler.

The high axle loads which have for a long time been permitted have not made it necessary for designers to sacrifice any attribute of the engine, such as the rigidity of the frame, in order to develop the boiler, and all the parts making up the running portions of the vehicle, notably the wheels, which are always of robust construction. The side frames, solidly braced together, and sufficiently stout buffer beams are excellent for preventing small breakdowns, especially those due to slight collisions in the running sheds or stations. In other words, nothing is sacrificed in order to save weight in parts which combine to make the engines sturdy. It has been realised that the underframe of the locomotive is one of the principal elements which go to the making of a robust whole, and to prevent frequent visits to the workshop.

The British locomotive is designed, built and adapted to operate on really good roads. The compensating levers are not generalised, the springs are fairly stiff, and the rigidity is relatively great in view of the work it is called upon to do, though I have noticed that they are somewhat "stiff" when running. American locomotives are built on an entirely different plan, and to give them the maximum flexibility they have three-point suspension, so that they may the better yield to the unevennesses of the lines, and although the roads of the Eastern States have been very much improved, three-point suspension, since it is regarded as having advantages, has been retained even on them. British locomotives, if called upon to run on indifferent lines, would not operate as well as they do in the country of their origin. Three-point suspension, which originated in the United States, has been nearly universally adopted on the Continent, where the engines built during the last thirty years have almost all embodied the system.

To sum up: In Great Britain, well laid and heavily ballasted, well drained and elastic roads and fairly rigid engines; in America and abroad, less good roads and flexible engines. It is partly owing to this flexibility that the American engine is exported to such a considerable extent, especially to newly opened up countries and to Colonies other than British. Canadian engines, it may be remarked, are, throughout, of American types.

Many British and continental engines are still provided with sliding bogies controlled laterally by springs, more or less developments of the Adams type of truck, which answered sufficiently well as long as the wheel base was moderate. Actually, one cannot too strongly recommend the use of articulated bogies with short rods or links, gravity-controlled, on the American system, which are more flexible and sensitive, without being too much so, if the proper inclination and length be given to the links. This question, however, involves a whole theory which there is not space here to discuss. If I do not mistake, it was the Lancashire and Yorkshire which was the first to employ in England, as its standard model, an articulated truck of this type. With the exception of the Great Western the companies generally make use of inside frames for the bogies of their engines, and I think with reason.

Suburban services, which have been so extensively developed in England, and a considerable number of which are now electrified, have led to the creation of types of tank engines which are, as a rule, well designed. The accepted model has, for a long time, been the four-coupled, with a bogie either in front of or behind the coupled wheels—South-Eastern, Great Northern, &c. As in other countries, the water tanks are at the sides, but the coal bunkers have always been at the rear of the footplate and not in front of it or at the side, as in so many continental engines of the same period, though that arrangement has now been abandoned. Nowadays, as said above, the power of these British tank engines has been considerably increased, and those most recently built belong to the 4–6–2 or 4–6–4 types. The cylinders are almost always inside, except when there are three of them.

British goods engines formerly exhibited very little variety, and were invariably six coupled with inside cylinders, the fire-box being taken down between the two rear axles. The wheels were of relatively large diameter, for the speeds of both mineral and goods trains was high. This type, which was remarkably well suited to the service it was intended to perform, continued in favour for some sixty years, and was enlarged by stages up to the extreme limit, as, for example, on the old Great Northern. Subsequently, with the object of more economical working, and so as to be able to deal with heavier loads, several lines abandoned the 0–6–0 engines and built some of the "Mogul" type, then—more frequently—the 2–8–0 and 2–8–2 types. Locomotives with eight-coupled wheels have for sixty years been in use on the Continent, especially in France, where the goods trains were heavier and lower axle loads permissible than in England, but their boilers were much less powerful than those which are now being employed. It is interesting to note that the Northern Railway of France, as early as before 1862, had built some engines of the 0–8–0 "Petiet" type, which have now disappeared from the main lines, and in which the wide fire-box was taken back over the rear coupled wheels, the small diameter of the wheels permitting of that arrangement. At the present time several of the French lines have put into service some very powerful engines of the "Decapod" or "Mikado" types, the use of which is destined to extend.

On the Continent—in France especially—a development has taken place in locomotives similar to that which I have mentioned as having occurred with other rolling stock. It passed, without a long transition stage, from old—sometimes very old—types, often having considerable overhang and three or four axles, to engines of great power and of the most modern design from all points of view.

England for a long time held the view, which was formerly generally accepted throughout Europe, as to the desirability of keeping the centre of gravity as low as possible, but she was one of the first to recognise the great error of that idea. In the early eighties Reynolds said:—"The safest engines running are high-pitched," but at that time, it must be admitted, no one dreamed that one should follow the examples of the Americans and arrange the axis of the boiler at 9ft. or even 10ft. above the rails. The development of the locomotive was only possible after the time when the fallacy of this prejudice was realised, and engineers were able to give to the barrel of the boilers diameters which are customary at the present day and which permit of increasing the number of tubes and the extent of the heating surface, and consequently of the grate area. In this connection it is to be observed that in the United Kingdom the boilers cannot be raised as high as is possible on the Continent and in the United States of America, because of the restriction of the loading gauge, which is nearly a foot lower than on the Continent, but the result already achieved on the London and North-Eastern Railway proves that it is possible to go a good long way in that direction.

In few countries locomotive engineers have paid so much attention to the standardisation of the various parts of their engines as in England. The question was in dispute for a long time, it being contended by many that such standardisation might stand in the way of progress; yet it has actually rendered great service. No line, so far as I know, carried the system further than did the Lancashire and Yorkshire at the time when Sir John Aspinall was its locomotive superintendent. All the new engines, whether for express passenger, for suburban or for goods traffic, had the same boiler; they only differed from one another in the number, diameter or arrangement of the coupled wheels, and the frames. This disposition, which proved of the greatest service, could not, however, be persisted in when it became necessary to increase the dimensions and power of the locomotives for certain services. But, in any case, it must be admitted that few foreign lines have been able to arrive at the result achieved generally throughout Great Britain in the direction of reducing the variety of spare parts for locomotives, notably as regards rods, accessories, cocks, valves, &c. That is a practical consideration which is certainly not without value, and which has been due partly to special foresight and partly to the facts that at one time engines of the same type were built in large batches, and that British engineers attempted to modify the types of locomotive less frequently than did those of other countries. At one time one company—the Great Western—departed from this general rule to a greater extent than any other, for it had on its effective list a large number of very different types of engines. However that may be, the reduction of the number of parts which have to be kept in store, as the result of a consensus of opinion concerning the more or less important parts, is a problem the solution of which is very important and desirable.

The tenders used in England have always been of small capacity, even on engines making long trips. They are generally mounted on three axles, and less often on bogies. Their water tanks have seldom a greater capacity than from 15 tons to 16 tons, thanks to the general use of water troughs for picking up water *en route*, which were introduced in 1862 on the London and North-Western by Mr. Ramsbottom and which several other great lines have since adopted. They give good results because they are managed in a rational manner, that is to say, they are carefully looked after, frequently cleaned, and kept clear of dead leaves and other foreign bodies which might find their way into the injectors and prevent them from working. The general use of water troughs is one of the most important progressive steps which was taken very early by English railways.

British tenders are built in the same style as are the locomotives, and are not looked upon, as in the United States of America, and on some European lines, simply as vehicles for carrying supplies of water and coal. They are constructed with the greatest care. The rivets of the tanks are countersunk and the panels are painted and varnished as are those of the engines of which they form the complements. They are maintained in a condition of the greatest cleanness, and they form, in fact, prolongations of the engines.

THE MOTOR SHIP DANMARK.

THE motor ship Danmark, which was recently completed by Burmeister and Wain, Ltd., of Copenhagen, is the latest addition to the fleet of the East Asiatic Company. The fleet numbers no less than twenty motor vessels, with an aggregate tonnage of about 191,000 tons deadweight carrying capacity. Like her sister ships, the Danmark is built without a main funnel. She has a length of 460ft. between perpendiculars, with a deadweight carrying capacity of 12,400 tons. Her draught when fully loaded is 28ft. 6in., and she is designed for a service speed of about 12½ knots. The propelling machinery comprises two standard six-cylinder four-cycle single-acting Burmeister and Wain motors, designed to develop a total of 5400 indicated horse-power at a normal speed of 115 revolutions per minute. All auxiliary machinery, both on the deck and in the engine-room, is electrically driven, current being furnished by three sets of 65-kilowatt capacity Diesel electric generators. After a successful trial trip, the vessel recently left Copenhagen on her maiden voyage to the Far East.

INSTITUTION OF NAVAL ARCHITECTS' PREMIUMS.—The Council of the Institution of Naval Architects has awarded two premiums for the year 1925, one to Mr. C. Frodsham Holt, D. Eng., for his paper on "Stability and Seaworthiness," and the other to Mr. G. H. Hoffmann, for his "Analysis of Sir John H. Biles's Experiments on H.M.S. Wolf in the Light of Pietzker's Theory." The premiums will be presented on March 24th next at the opening of the annual general meetings, which will be held at the Royal Society of Arts, John-street, W.C. 2.

Marine Turbine Governing and Forced Lubrication Failure Control.*

In the year 1901 the first turbine-propelled steamer to carry passengers was launched from Denny's yard at Dumbarton. She was engined by the Parsons Marine Steam Turbine Company, Wallsend-on-Tyne, and with her will be associated the name of Captain John Williamson of Clyde fame. This historical vessel, as we all know, is the veteran King Edward. She was, I believe, fitted with Proell governors, with mechanical connection to the emergency valve, which was of the butterfly type. In the year 1905 I had the honour at the completion of my apprenticeship to be engaged upon the blading and brazing of the first turbine-driven vessel built by the Fairfield Shipbuilding and Engineering Company, the ss. Narcissus. She had, if my memory serves me, a peculiar form of "emergency control" in which I took particular interest.

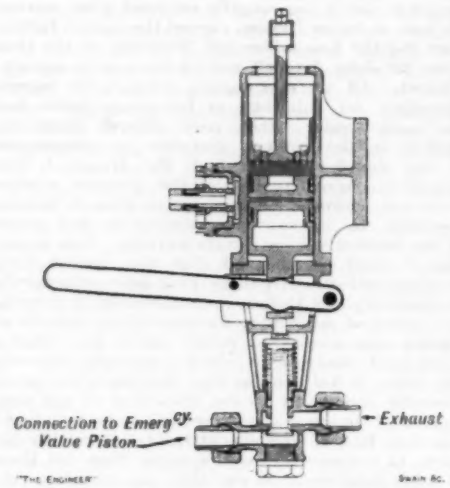


FIG. 1—GOVERNOR FOR CONTROL BY AIR TRANSMISSION

She was a twin-screw direct-driven vessel with high-pressure turbine on one shaft and low-pressure on the other for ahead drive, with an independent astern on the high-pressure shaft and an incorporated astern in the low-pressure turbine on its shaft for astern drive. A Proell governor was fitted to each shaft. The governor operated the emergency valve of single-beat type through a steam relay.

My next association with turbine control was in the drawing-office of the same firm. I was responsible for the governor arrangement of the two mail steamers Heliopolis and Cairo, built by Fairfield for Egyptian service. These vessels had Proell governors, operating a butterfly throttle valve through a weight relay. Other builders had more or less adopted the same arrangement, which continued in vogue for a good number of years. With this type of governor the makers seemed to have difficulty in adjustment. The governor was of the slow-speed type, geared down from the turbine, and in this I think lay the source of trouble. I know that in the Heliopolis the governors

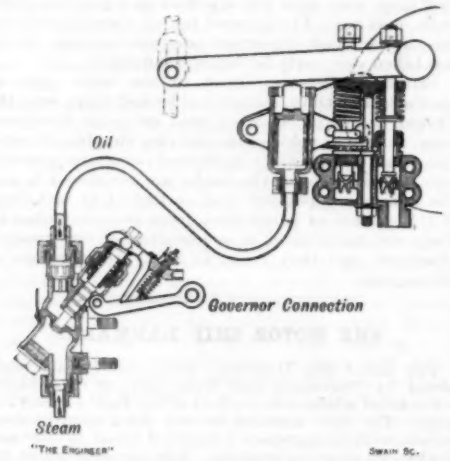


FIG. 2—ARRANGEMENT FOR CONTROL BY LIQUID TRANSMISSION

cut out too early and had to be disconnected on trial. For this reason also they were abandoned in the Royal Navy, although governors never had been popular in the Navy even in reciprocating work. Of course, the reason for this will be appreciated.

While in Fairfield I had realised, particularly in connection with naval work, the inefficiency of the butterfly throttle valve. On joining my present firm, I gave this matter particular attention, and came to the conclusion that a saving in first cost and a much more suitable valve would be obtained by incorporating the emergency valve in the bulkhead self-closing valve. In addition, the weight of the combination would be much less than the two separate fittings. This arrangement was most suitable for naval turbine work, and was quickly adopted. It also found favour in mercantile design. The main valve being steam operated, the governor had only to act on the control valves, and while the governor effort was too weak to actuate the control valves direct, still smaller weights could be used in the relay, or inversely, if the same weights were used there was a greater degree in certainty of action. In connection with this fitting, Messrs. Parsons suggested that it might be possible to arrange to actuate the control valves direct from the governors; in other words, to abolish the weight relay between the governors and the operating gear on the emergency valve. The simplest arrangement that presented itself was to substitute the weight relay by a spring on the valve. Quite a number of turbine-driven vessels were fitted with this arrangement.

It will be appreciated that in arranging for the mechanical connection between the governors and the emergency valves many difficulties presented themselves. Even allowing that the designer could go straight forward in the drawing-office, each governor had to be connected up to a shaft running in front of the turbines, and this shaft again had to have its effort transmitted horizontally to connections on the bulkhead. From this point a lead had to be got up to the emergency valve situated possibly some 15ft. to 20ft. above. The problem was a most difficult one if the governor arrangement came up for consideration after other engine-room arrangements had been proceeded with. Apart from all this, the torque of the shaft connecting up the governors, play in joints, &c., the unknown frictional resistances due to slight want of alignment, &c., introduced factors that made it most difficult to arrange for correct travels and efforts at the emergency valve. Again a considerable portion of this connecting gear was below the floor plates, and could not possibly receive the attention necessary to it. From what I have related it will be conceived that much time must, of necessity, be spent in the drawing-office, as well as in fitting up to ensure the proper functioning of a mechanically operated governor control. This was most forcibly brought home to me during the war, when I had to visit a number of vessels at various ports for overhaul work. I consequently gave considerable study to the simplification and cheapening of governor control. As an outcome of this, I felt convinced that a fluid form of transmission was the most desirable as pipes could be led wherever, convenient. In the meantime various turbine builders had adopted a type of governor or emergency control connected directly to the rotor spindle without the intermediary of reduction gear. This made for a more sensitive control. I felt this was a step in the right direction.

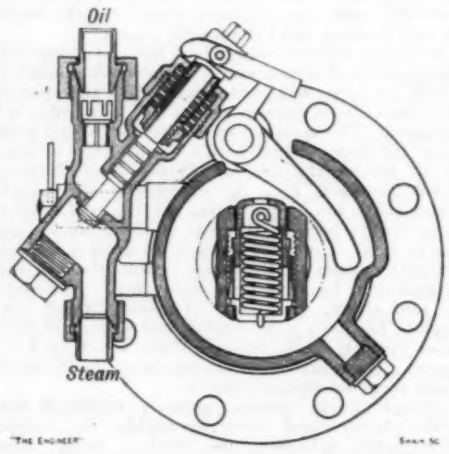


FIG. 3—GOVERNOR FOR LIQUID TRANSMISSION

A fluid form of transmission was used in the ss. Narcissus, as I have already mentioned, but it was not repeated by the Fairfield Company in any of their subsequent vessels. I considered a similar form of fluid transmission in connection with a peculiar form of governor invented by Mr. George Taylor. This governor is shown in Fig. 1. The governor essentially consisted of a piston constantly working in a cylinder, with a spring-loaded air valve. The air valve was set to close at a certain velocity or pressure of the air, this corresponding to the governing or emergency cut-out speed. As soon as the air valve closed, the air was compressed and opened the steam relay valve. This valve worked on the exhaust system; that is, exhausted steam from under the piston of an emergency valve. The arrangement was experimented with and worked fairly satisfactorily. At the same time it appeared to me that in long lengths of relay pipe from the emergency valve and where in turbine work the relay control valve would be much below the emergency valve, the quantity of water collected in the pipe would be considerable, and it will be appreciated that as the pressure to get rid of this water, was quickly reduced on the opening of the control valve, the emergency valve might take some time to close. The alternative to this arrangement was, of course, to supply steam to, instead of exhausting from, the piston on the emergency valve. What deterred me from pursuing this scheme was the possible effect of water hammer. I more or less dropped the proposition of fluid transmission until the war period already mentioned.

On again approaching the question of fluid control, it appeared to me at the time that a steam relay on the pressure system would be the most suitable, provided water hammer could be obviated. By this time our bulkhead emergency valve for turbine work had been adopted; consequently, the problem was greatly simplified. Instead of having to operate the emergency valve direct from the steam relay, it was only necessary to operate the control valves. As already stated, it was appreciated that the steam supply pipe would normally be full of water from its connection to the steam main down to the control valve at the turbine. Now it seemed a more or less simple matter to fill the pipe between the control valve at the turbine and the control mechanism on the emergency valve with water or oil, so that when the governor tripped the control valve, the effort was transmitted to the water or oil in the pipe to the control mechanism. This arrangement is shown in Fig. 2, and numbers of marine turbine installations were fitted with this method of transmission working in conjunction with Proell, Hartnell, Westinghouse and other governors.

It appeared desirable to standardise the type of governor to work in conjunction with this transmission, and accordingly the combination, as shown in Fig. 3, was evolved. Fig. 4 is a diagrammatic arrangement of this system. At this period my firm—Cockburns, Ltd.—were asked if they could effect a control in case of the failure of the forced lubrication. While in the case where gravity tanks can be fitted and a short time elapse before damage occurs, during which period the pumps may be started again or the machinery stopped, there is not the same necessity for a control, although still desirable. On the other hand, with direct pressure systems there is no time to do anything after the pumps stop, consequently an emergency control is essential.

Messrs. Scott, of Greenock, also appreciated the great desirability of a forced lubrication control, and synchronously with Cockburns, Ltd., and Messrs. Aspinall's, of

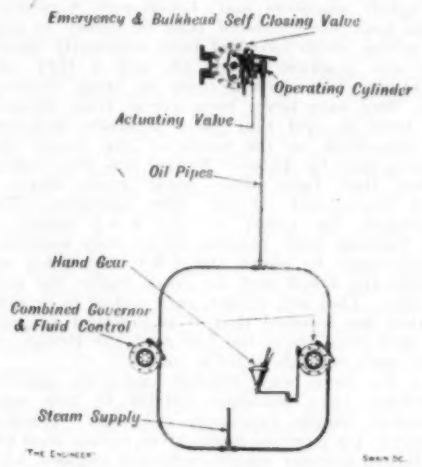


FIG. 4—ARRANGEMENT FOR LIQUID TRANSMISSION

Liverpool, developed a combined governor and lubrication failure control. These three firms have been associated with the introduction of governor and lubrication failure control as it is known to-day. In the first instance, the governor combination was slightly modified. In using the lubrication oil pressure to keep a small exhaust control valve shut on the emergency valve, if the pump stopped, the lubrication pressure dropped and the exhaust control valve opened. Further, the governor only required to trip the control valve to drop the oil pressure, and again open the exhaust control valve. In both cases, of course, the emergency valve shut down.

Up to this juncture, turbine governor controls had more or less been of the emergency cut-out type; that is to say, that there was no governing period as is the case with an Aspinall governor for reciprocating work. In the turbine the governor cut right out and had to be reset. This meant that if the governor was too closely set to the normal revolutions, it was liable to become a source of nuisance. The result was that the governor was set as high as possible, which meant that no control took place until the revolutions were considerably over the normal, so that in the event of broken teeth or a broken shaft, the steam left between the emergency valve and the turbines might be sufficient to spin the turbines to a dangerous speed. It appeared to me that if a governor could be arranged to cut out and cut in, in a simple manner, it would be a highly desirable fitting. This meant that governing would take place close on the normal revolutions, leaving the emergency cut-out at the higher revolutions. So that in the event of stripped teeth or a broken shaft, the control would be effected sooner, and the final speed before starting to slow down not so much over the emergency cut-out as previously. To this end the governor, as shown in Fig. 5, was developed and experimented upon with most satisfactory results. The governor proper consists of two balanced valves, abutting each other at the axis of the turbine spindle and spring loaded to the desired speed. These two governor valves commence to govern between 5 and 10 per cent. over the normal revolutions, and between 10 and 20 per cent. over the normal revolutions the emergency pawls engage and lock the valves out; that is to say, up to 10 per cent. increases the valve open and shut, and thus effect a steam control through the medium of the lubrication oil. Above this speed, the steam is shut off altogether. Sometimes it is desired to have a definite governing speed of, say, 5 per cent. over normal and a

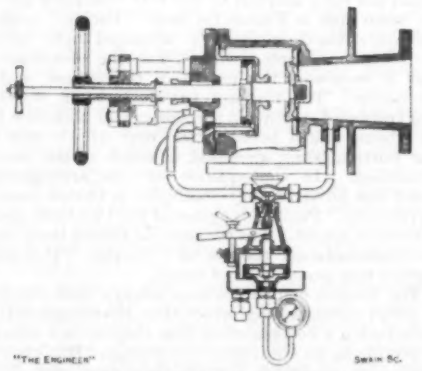


FIG. 5—COCKBURN GOVERNOR

* From a paper read by Mr. Donald MacNicoll to the Scientific Society of the Royal Technical College, Glasgow, on Feb. 6th, 1926

definite emergency control, say, at 18 per cent. To effect this one of the pawls is taken away. The valve from which this pawl is taken is then set to govern at 5 per cent., and the other valve with the remaining pawl set to lock out at 18 per cent. In conjunction with this governor the emergency shut-off valve was modified, and instead of the control being effected by exhausting steam from the piston, the emergency valve closed by supplying steam to the piston. A hand control and pressure adjusting device was fitted, for without it, if the pressure in the lubrication system was, say, 12 lb., the control would commence about 2 lb. With the adjusting device, it can be arranged to cut out at any pressure between 2 lb. and 12 lb. Fig. 6 shows a fitting that is sometimes adopted to effect a control, should either the bearing or sprayer oil supply fail. This is termed a differential control valve. The sprayer oil comes in at A and the bearing oil at B. C is the connection to the emergency valve, while D is that to the governor. The differential control valve may be in any position. As long as pressure is on the back of both valves, the oil will pass to C and D, but if the

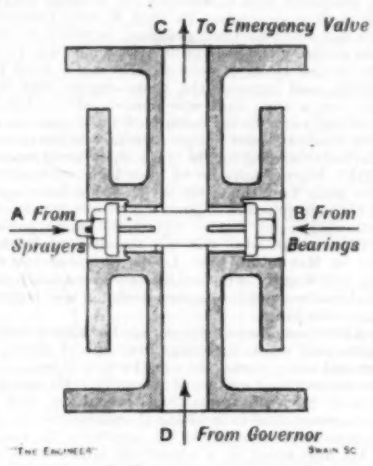


FIG. 6—DIFFERENTIAL CONTROL VALVE

sprayer oil supply fails, the valve moves over with pressure from B until it closes. The pressure then drops in C and D, and the emergency valve is shut. If bearing oil supply fails, the emergency valve is shut in a like manner. Fig. 7 shows in diagrammatic form the arrangement of governors and forced lubrication failure control.

There was a period in marine turbine history when the want of a sound governor, and particularly the want of efficient transmission, made it very doubtful as to whether it was worth while fitting a governor. It has been asserted from time to time that the geared turbine never raced in heavy weather, and that that was another reason for dispensing with the governor. I will cite two cases that apparently disproved the assertion. The first case was a large liner engaged on the North Atlantic trade. The chief engineer had experienced heavy weather, and he noticed that during this time the steam chart showed that the steam was being shut off at regular periods. He could not understand this at first, until he thought of the governors. He decided that during the next heavy weather he would watch the emergency valves, which he did, and

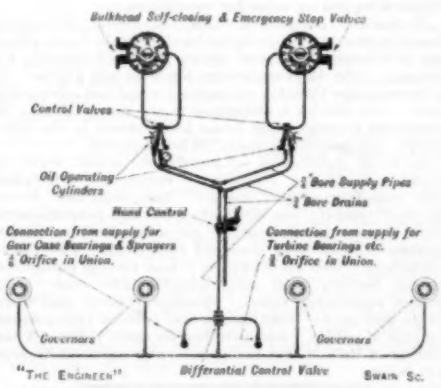

Bulkhead Self-closing & Emergency Stop Valves
Control Valves
Oil Operating Cylinders
Hand Control
Connection from supply for Gear Case Bearings & Sprayers ¼ Orifice in Union.
Connection from supply for Turbine Bearings etc. ¼ Orifice in Union.
1" Bore Supply Pipes
½ Bore Drains
Governors
Governors
"The Engineer"
Differential Control Valve
Swain Sc.

FIG. 7—COMPLETE ARRANGEMENT

found that they regularly closed and opened up again. The other case was one of the largest liners engaged upon the Pacific trade, and incidentally belonging to the same steamship company. In this steamer the ahead manœuvring valves were actually shut down to allow of only 60 per cent. of full power. Still in heavy weather the turbines accelerated until governing was effected. These are two concrete cases. I made inquiries as to why this increase was not shown on the tachometers, but could not get a satisfactory explanation. My own theory is that from the principle of a tachometer, it cannot in all cases respond quickly enough, and that consequently at certain rates of acceleration the speed is up and down again before it shows on the tachometer. For instance, the propeller comes out of the water, the turbine spins up to the governing speed, the tachometer is lagging, and before it can register, the propeller is back in the water again, and the revolutions are quickly being dropped. From this it can be easily appreciated that if no governor is fitted to a turbine in heavy weather, although the race may not be sufficient to burst the turbines, it may cause considerable stress and resultant strain in the blades, &c.

The Activated Sludge Process of Sewage Treatment.

IN the Lecture Hall of the Institution of Civil Engineers, on Friday, February 26th, a Chadwick Public Lecture, entitled "The Activated Sludge Process of Sewage Treatment," was delivered by Dr. H. T. Calvert, of the Ministry of Health. It is an exceedingly able discussion of this interesting subject and is worthy of careful study. It is, unfortunately, too long for us to reprint in full, but some of its leading points are dealt with in what follows.

The lecturer, after some introductory remarks concerning the founder of the Chadwick Public Lectures, went on to say that all artificial biological methods of sewage treatment, whether by means of contact beds, percolating filters, or activated sludge, were really developments of the "intermittent downward filtration through land" process of Frankland, and when once the principles underlying that process had been grasped the mechanism of these newer processes was easily understood. Oxygen was, the lecturer said, the purifying agent and the air furnished a practically unlimited supply of that gas. If oxygen were brought in contact with organic matter at the ordinary temperature, oxidation proceeded only slowly, but at higher temperatures the same process took place more rapidly. It was then termed combustion, and that was the process which took place in refuse incinerators. It was obviously impracticable to evaporate sewage and oxidise the remaining organic matter in a refuse incinerator, and hence in sewage purification we had to aim at oxidising the organic matter by introducing oxygen in the concentrated or active form in which it occurred in various chemicals (such as permanganates) or by having present along with the oxygen some other substance which hurried up the process of oxidation. The former method proved more expensive than the latter, which was the essential feature of land treatment and artificial biological methods. The other substance which hurried up the process of oxidation was a biological one, either bacteria and other micro-organisms or even larger living organisms, but the actual mechanism of the change was not yet thoroughly understood.

Apart from all theories we were on safe ground if we said that the presence of organisms enabled the oxygen of the air to oxidise the organic matter in sewage very rapidly, and it remained to consider what were the best methods of bringing the three reacting substances—the organic matter of the sewage, the oxygen of the air, and the organisms—into as intimate contact as possible. In land filtration each particle of the soil became coated with a gelatinous film derived from the organic matter of the sewage. This film formed a nidus for organisms, and at the same time such an extensive surface that it attracted more organic matter out of the sewage, and a partially purified liquid passed on to the next particle of soil, where the process was carried a stage further. Following the sewage came a supply of air, and we thus had the three reacting substances together. Oxidation took place and the gelatinous film on the soil particle was ready for another dose of sewage. In the case of contact beds and percolating filters the mechanism of the process was somewhat similar, except that the material of the beds and filters was very much larger in size than the soil particles, whilst in the case of the activated sludge process the particles of soil or other filtering material were entirely dispensed with and the gelatinous film or activated sludge was agitated with the sewage, and air was either blown in or supplied at the surface of the agitated mixture of sewage and sludge.

The Action of the Oxygen.—From what had been said, the lecturer continued, it would have been gathered that activated sludge was produced from the organic matter of sewage and that it was an oxidation product of that organic matter, but the exact function of the oxygen of the air in the production of activated sludge was as yet undetermined. It might be that it fostered the growth of micro-organisms pre-existing in the sewage or even in the air, or that it killed off another kind of micro-organism, or again it might be that it destroyed certain constituents of the organic matter or sludge which were inimical to its use for the purpose of purifying further quantities of sewage, or the action might be a mechanical one in developing an enormous surface area on the sludge; but experiments had shown that the addition of chloroform, toluol, and other substances which killed micro-organisms to a fully activated sludge impaired or destroyed its activity. We were therefore justified in assuming that activated sludge owed its activity in great part at any rate to the micro-organisms which it contained.

His hearers would, Dr. Calvert added, note that an attempt had been made to define activated sludge rather by its method of production than by the properties which it possessed and to show how the activated sludge process was a further development of the older processes in the direction of concentrating the process of purification into a smaller space. For their present purposes the principal properties of activated sludge were: (1) Its ability, when mixed with sewage and aerated, to remove organic matter from the sewage so that a purified or partially purified effluent could be readily obtained; (2) its higher nitrogen content than ordinary sewage sludge obtained by the settlement of sewage solids in tanks, with a consequent higher manurial value; and (3) its high water content, which increased the difficulty in disposing of it in many cases, as compared with ordinary sewage sludge.

Variations in Method.—The lecturer then went on briefly to refer to the various methods of treatment by the activated sludge system which had been introduced, reviewing in turn (*a*) the original method by blowing, as introduced in the first instance, and its developments; (*b*) the bio-aeration method; (*c*) the "Simplex" surface aeration method; and (*d*) the "Spiroflow" method, with all of which our readers are familiar. He also discussed at some length the modification which had been worked out at Birmingham, where, he explained, experiments were undertaken, some five or six years ago, to ascertain whether the Birmingham sewage could be treated by the activated sludge process, and those experiments were so carefully supervised and recorded that very important results were obtained. Not only were the end results recorded, but the course of the purification was carefully followed, and it was found that by submitting the sewage (in that instance a partially settled and septic sewage) to the activated sludge process for one hour a 60 per cent. purification could be obtained, whereas eight or ten hours were necessary to obtain complete purification in the sense in which that had already been defined. In the case of the Sheffield method it was found that a large amount of purification had already been effected in the first few channels of the agitation tank and that the remainder of the channels were used for the reactivation of the sludge in contact with the purified sewage. At Birmingham the basic idea was to stop the purification process at an early stage, separate the partially purified liquid from the partially deactivated sludge, and reactivate the sludge separately for re-use in the process. The partially purified liquid was then passed on to existing percolating filters at a rate of two or three times the ordinary rate of feed. The short period of agitation enabled the plant to be constructed correspondingly smaller, but the reactivation or re-aeration of the sludge in the concentrated form was a more difficult matter than in the dilute form, so that the size of plant necessary for that part of the process was not reduced strictly in proportion to the concentration of the sludge. A large-scale plant to deal with 2½ million gallons per day had been operated on those lines for some time at Birmingham, and the size of the plant was now being trebled. Local conditions made the process peculiarly applicable at Birmingham. The settlement tanks were situated some four or five miles higher up the valley than the percolating filters, and, in traversing the carrier between the two portions of the works, the tank liquor became septic and was liable to give rise to nuisance from smell when it was sprayed on to the percolating filters. The partial treatment, or bio-flocculation, as it had been termed, for it consisted essentially in a flocculation of the colloidal organic matter in the sewage, deprived the sewage of its septic character so that no nuisance from smell was caused when the sewage was sprayed on to the filters, and owing to the high rate of feed of the filters the normal extension of filter area to meet the needs of increasing population was avoided. It was also probable that with this partially purified liquor the question of fly nuisance on the percolating filters would be lessened.

The process was, said Dr. Calvert, a peculiarly inviting one, for there were few large towns in a position to require or should he say, to afford absolutely new sewage disposal, works, and most of the activated sludge plants installed in this country had been adjuncts to existing works which required extension. In most cases they dealt with a portion of the whole flow of sewage and not with the whole flow and its daily variations. The process in use at Birmingham afforded an opportunity of extending existing works, especially where percolating filters existed, without separating the works into two parts and without constructing further expensive percolating filters.

Manurial Value.—Activated sludge had a higher percentage nitrogen content than ordinary sewage sludge, and percentages of 5 or 7, measured on the absolutely dried sludge, were not uncommon; but whether that higher nitrogen content was due to the fact that it contained the colloidal matters of the sewage or whether the sludge had absorbed soluble ammoniacal compounds out of the liquid, or whether it resulted from a preferential fermentation of the carbonaceous organic matter of the sewage, further experimental work must decide. The phosphates of sewage were also absorbed by activated sludge.

The comparatively high nitrogen content of activated sludge led to experimental work upon its manurial value, but it was probable that the good results which had been obtained were due largely to the humus-forming constituents of the sludge rather than to its content of nitrogen and phosphates. Pot cultures and plot experiments had been carried out at the Rothamsted Experimental Station of the Lawes Agricultural Trust, at the Withington works of the Manchester Corporation, and in Canada and the United States. These experiments had fully demonstrated that activated sludge possessed a higher manurial value than ordinary sewage sludge, and that its nitrogen was as available for plant life as the nitrogen of sulphate of ammonia. For horticultural work and the dressing of golf greens and in market gardens the activated sludge produced at Milwaukee and Chicago had been dried and put up in 100 lb. bag and had found a ready sale.

The problem of using activated sludge as a fertiliser had not yet been tackled seriously in this country, and at the various works where it was produced it had been dealt with much on the lines in which ordinary sewage sludge had been dealt with: by shallow ploughing into the land, by lagooning, or by drying on special drying beds and then spreading on the land. At most works it was mixed with the ordinary sewage sludge produced at another part of the works, but in no case had a preliminary dewatering in presses or filters with subsequent drying by heat in mechanical driers proved successful. At Milwaukee and other places in America very large plants had been constructed to deal with the sludge on those lines, but whether the success which was reported from the plants was due to some difference in the American sludges or to a want of vision on our part was uncertain.

The difficulty seemed to lie in the preliminary dewatering of the sludge, but where local conditions were suitable there was no reason why the wet sludge should not be pumped to the farms, as was done with ordinary sewage sludge at Wolverhampton and Blackburn.

Experiments on the drying of the sludge on specially constructed ash or sand filters in which the sludge was spread in layers not exceeding 4in. or 6in. in thickness had been more successful, but that method must be regarded as a rather expensive one to be used as a preliminary process to drying by means of heat. The fermentation of mixtures of activated sludge and pulverised or screened house refuse was another line of investigation which was being pursued with promising results.

The Question of Cost.—Some reference would no doubt be expected to the cost of the process, the power consumption, and the size of plant which might be regarded as the smallest economical unit. It must be realised that local circumstances varied so enormously, not only with regard to the site of the works, but also with the strength or nature of the sewage to be dealt with, that in spite of the very full information which had been kindly supplied by those responsible for several of the plants which were

operating in this country, it had not been found possible to do more than indicate that the capital constructional costs of a plant to deal with a daily dry weather flow of a million gallons of average domestic sewage, and with three times that volume in wet weather, would be under average conditions approximately £30,000, and the annual working costs from £1200 to £1400. The power required had been found to vary from 15 to 30 horse-power per million gallons, but the price of electrical power varied at the several plants from ½d. to 4d. per Board of Trade unit.

Conclusion.—In conclusion, Dr. Calvert remarked that he hoped that from what he had said that the impression had been created that there was a chasm of ignorance concerning the activated sludge process of sewage treatment, and that whilst our imperfect knowledge had been sufficient to justify the expenditure of large sums of money on the process, there was a crying need to plead for further scientific research. When we had replaced our ignorance by real knowledge we should then, and not till then, be in a position to define the future possibilities of the process, but there was every reason to expect that those possibilities would be large.

A Diesel-Electric Locomotive.

THE Diesel-electric locomotive which is illustrated on this page was built by the Baldwin Locomotive Works for experimental and demonstration purposes. The engine, which is of the solid injection, two-stroke cycle type, has twelve cylinders arranged in two groups of three pairs each, the pistons in the two cylinders of each pair driving on to separate parallel crank shafts. Each shaft carries a herring-bone gear wheel which meshes with a pinion on the generator shaft and raises the crank shaft speed of 450 revolutions per minute to 1200 revolutions per minute. The cylinders are 9¾in. by 13¼in. and each pair has a common combustion space enclosed by a single head casting and supplied with fuel through a single injection nozzle. The cylinders incline outwardly at the bottom at an angle of about 16 deg. with the vertical.

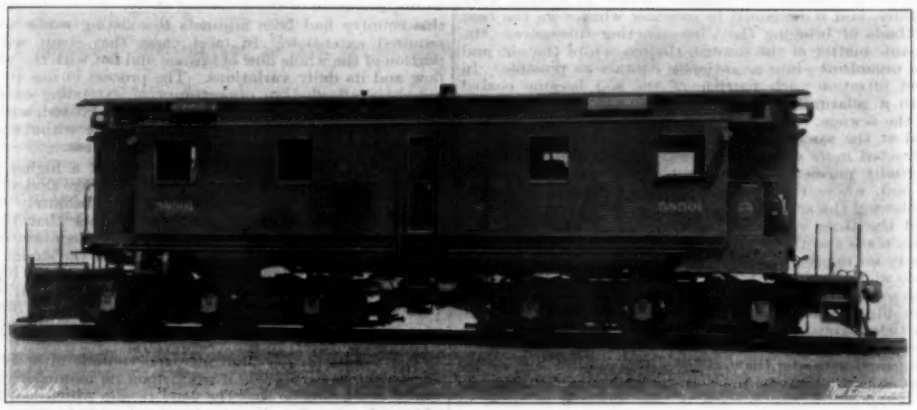
For the purpose of effecting a complete scavenging the pistons on one side of the engine are given slight angular advance on those on the other side. The circulating water is cooled in large radiator compartments at each end of the locomotive. These compartments each house a radiator and a fan which exhausts through openings at the top of the sides of the compartment. One fan is driven mechanically by the engine, while the other is driven by a constant-speed blower motor.

Compressed air for the air brake system and for the electro-pneumatically operated switches and cam groups is furnished by three 600-volt electrically-driven Westinghouse compressors, each of a capacity of 50 cubic feet of free air per minute. To one of these compressors a small four-cylinder petrol engine may be attached by a clutch when it is desired to raise the pressure in the main reservoir to 120 lb. for starting.

A Westinghouse 750-kilowatt, 750-volt, self-ventilated, separately-excited, direct-current generator is direct connected to the oil engine by a flexible coupling. This generator furnishes power to four 200 horse-power axle-mounted, self-ventilated traction motors which are direct geared to the axles by a flexible gearing which permits a slight movement of the rims with respect to the gear centre, thereby absorbing possible shocks to the driving mechanism incident to starting the locomotive.

The engine is controlled by a Westinghouse electro-pneumatic gear from either end. It is accelerated from rest by the manipulation of the two levers on the master controller. A throttle lever is used for controlling the speed of the oil engine, while the field lever just below it is used for connecting the traction motors to the main generator and for varying the main generator field resistance during acceleration. The main motors are connected to the main generator by the closing of four electro-pneumatic unit switches. The main generator field resistance is varied by the operation of magnetic contactors. The variation of both engine speed and main generator field resistance serves to vary the voltage of the main generator, thus causing the main traction motors to change the speed of the locomotive. A third or reverse lever on the master controller is used to direct the movement of the locomotive forward or backward. The reverse lever, with two positions in both forward and reverse, also controls the operation of the field change-over cam group. The first position gives the full field connection of the main motors for acceleration of the locomotive; the second gives the short field connection of the main motors, which allows the operator to utilise the full engine horse-power at higher locomotive speeds than can be obtained with the full field connection. A series-parallel cam-switch group provides series-parallel operation of the main traction motors, and this position is used ordinarily for shunting service.

This Diesel-electric locomotive has been in trial service on several railways during the past few months. On the Reading Railroad 1000-ton trains were handled from Reading to Tamaqua, about 40 miles distant, with an average of 3·3 gallons of fuel oil per 1000 gross ton-miles. On this section about three-quarters of the distance is an up gradient of ·7 per cent., over which a speed of 16 miles an hour was maintained; travelling in the reverse direction with 2000-ton trains the fuel consumption was 1 gallon per 1000 ton-miles. Its tractive effort is given as 52,200 lb.



AN AMERICAN DIESEL-ELECTRIC LOCOMOTIVE

Matthew Murray.*

MATTHEW MURRAY was born in Newcastle-on-Tyne, in 1765, and was apprenticed to a smith or millwright. When still quite a young man he went to Leeds looking for work, and was fortunate to find occupation with a Mr. John Marshall, who was amongst the first to use machinery in the flax manufacture. Beginning as a handyman, Murray was soon made chief mechanic, and for several suggestions and improvements, Marshall subsequently presented him with £20. After a time, the business began to improve rapidly, the old water mill became too small for the work, and Marshall in 1790 decided to move into larger works nearer Leeds, and, in partnership with Mr. Benyon, he started a mill in Holbeck. About this time Murray took out his first patent—No. 1752 of 1790—which was for "a machine for spinning flax, cotton, silk, &c." When he had been with Marshall about twelve years he was invited to join James Fenton, David Wood, and William Lister, in establishing works for making and repairing machinery and engines, there being no facilities of the kind in Leeds at the time. Fenton found most of the capital, Murray taking charge of the engine building department, and Wood of the construction and design of the machinery. The firm afterwards became Fenton, Murray and Jackson, the latter being a relation of Matthew Murray. They first took a workshop in Mill Green, Holbeck, but finding it too small, soon removed to a site near to Camp Field, also at Holbeck, where, amongst other buildings, they constructed a large circular workshop, from which the works were, and are, generally known locally as the "Round Foundry." Here Murray devoted his entire energies to making improvements in the steam engine, which were afterwards the subject of several patents. Having built himself a house close to the works, he contrived to have it entirely heated by steam, hence it was known locally as "Steam Hall."

In 1801 Murray took out a patent—No. 2531—described as for "New Methods and Improvements of Constructing the Air Pump and Sundry other Parts." It included drop valves, valve gear, cylinder packing, parallel motion and a method of constructing boiler fireplaces for consuming their smoke, &c. In the following year, 1802, Murray, thinking that there might be a demand for a more simple and compact design than the beam engine, devised a type of vertical engine with all its parts arranged on a cistern containing the condenser, air pump, &c., and the patent—No. 2632—also included several forms of slide valves, including the well-known three ported valve. The title of this patent was for "New Combined Steam Engines for Producing a Circular Power, and for certain Machinery thereunto belonging, Applicable to the Drawing of Coals, Ores, and other Minerals, or for any purpose requiring Circular Power." The general arrangement somewhat resembled a table engine in appearance, with connecting-rods working downward, but the connection to the fly-wheel shaft was very different, being a species of parallel motion which depends on the principle that "a hypocycloidal curve formed by one circle rolling within another becomes a straight line when the diameter of the outer circle is twice that of the inner one." This form of parallel motion invented by Murray, was communicated by him to Mr. Jas. White, who published it in his "New Century of Inventions" in 1801, and who, when residing in France about that time, submitted it to Napoleon Bonaparte, from whom he received a medal. It is generally known as White's parallel motion. This engine was amongst the first to have a simple slide valve, which was worked by a wiper or cam. Several engines of this design were constructed, one of which was fixed at St. Peter's Quay on the Tyne, and is said to have worked uncommonly well for many years.

About this time Murray's firm threatened to become a serious rival to Messrs. Boulton and Watt of Soho Works, who hitherto had almost a monopoly of the steam engine trade. They sent Mr. Murdock and another of their engineers to Leeds, where they called on, and were cordially received by Mr. Murray, who showed them round the works. After their return Boulton and Watt almost immediately took steps to contest the validity of Murray's last two patents, which they managed to get set aside, on the grounds "that Murdock had in the one case proposed using similar circular drop valves," although he had not patented them, and in the case of the patent for the portable vertical engine "that the condenser and air pump were copies of Watt's arrangement."

Boulton and Watt purchased the land which at the time was vacant known as Camp Fields, and retained possession of it for a number of years, thus preventing any extension of Messrs. Fenton, Murray and Wood's works.

Instead of being discouraged by these rebuffs, Murray now applied himself with increased energy to the business, orders flowed in, and the next year, 1804, his firm began to send work abroad, an engine for Sweden being amongst the first of their foreign orders. Mill work and the making of machine tools were now undertaken, and several large boring machines and a machine for planing valves and similar work were made. In 1809 Murray invented and brought out a flax heckling machine, for which he received the gold medal of the Society of Arts, which was presented to him by the Duke of Sussex. He again tried further to simplify and improve the beam engine, and in 1810 brought out a type that was almost self contained, all the working parts being assembled on a cast iron plate with the condenser and pumps attached to the under side only the outer bearing for the crank shaft being separate.

In 1811, Murray appears to have been working in conjunction with Trevithick, for we find that he constructed one of his high-pressure engines which was fitted in a boat the following year, 1812. About the same period Mr. John Blenkinsop, who was the manager of Brandling's Colliery at Middleton, near Leeds, patented his railway system, and Murray, who had latterly given much thought and study to locomotive engines, designed and constructed the engine for him.

From this time Murray was engaged in almost every class of engineering work, including drainage of marsh lands, and gas and water works, the construction of beam engines, marine engines, and mill work generally. He was the first in Leeds to have the works lit with coal gas, and he was largely instrumental in inducing the authorities to consent to the construction of works for supplying the town with gas. He also acted as a consulting engineer to various manufacturing firms.

He died on February 20th, 1826, in his sixty-first year. After his death the firm of Fenton, Murray and Jackson continued the business for some considerable time, but the works were closed in 1843, and after being vacant some years were taken over by Messrs. Smith, Beacock and Tannett, machine tool makers, who re-named the premises "Victoria Foundry," although generally to Leeds people they are still known as the "Round Foundry."

* From a paper read before the Newcomen Society on February 24th, 1926, by Mr. G. F. Tyas.

CONTRACTS SECURED BY BRITISH FIRMS.

HIS MAJESTY'S Trade Commissioner at Vancouver—Mr. L. B. Beale—has informed the Department of Overseas Trade that the laboratories of the mechanical and electrical engineering departments of the University of British Columbia, which is under the administration of Dean R. W. Brock, Faculty of Applied Science, and Dr. H. Vickers, appointed to the Chair of Electrical and Mechanical Engineering, are now nearing completion as regards their equipment.

It is interesting to note that practically all the equipment thus far put in is of British make. The following items, all of British manufacture, have already been installed, or are on order for installation:—

Mechanical Laboratory.—One 50 brake horse-power Diesel engine; one Froude brake of 50 brake horse-power; one 10-kilowatt De Laval steam turbine connected to a dynamo, one 12 horse-power National gas engine; one 11 horse-power Crossley oil engine; one 3-ton refrigerating plant; one 250 kVA alternator in the power-house; one compound engine of 250 brake horse-power in the power-house; one marine engine of 50 horse-power.

Electrical Laboratory.—Two direct-current level-compound generators; one rotary converter, three-phase, with transformer and starter; one induction motor; one oscillograph; one alternating-current potentiometer; direct-current potentiometer, galvanometers, condensers, resistances, and other standard equipment; electrostatic voltmeters; four transformers; iron testing equipment; storage battery, 350 ampère-hours, 220 volts; high-tension switchgear panel; switchgear panel and instruments and gear; instruments and current transformers; samples of cables; and switches on main panel. A large number of British text-books have also replaced American text-books.

THE ASSOCIATION OF CONSULTING ENGINEERS.—The annual dinner of the Association of Consulting Engineers was held at the St. Stephen's Club, Westminster, on Thursday, February 25th. Over 150 members and guests sat down under the chairmanship of Mr. E. W. Monkhouse, M. Inst. C.E., M.I. Mech. E., M.I.E.E., the Chairman of the Committee of the Association, and, as is always the case with these periodical gatherings of the Association, a thoroughly enjoyable evening was spent. The feeling of good fellowship, which, as we have remarked before, always pervades the entertainments given by this society, was again in evidence, and the fare provided was, it goes without saying, excellent. After the health of the King had been drunk, the first toast was that of "The British Empire," which was proposed by Mr. C. G. Du Cane, M. Inst. C.E. It should have been replied to by Lieut.-Colonel the Right Hon. Wilfrid Ashley, Minister of Transport, but he, unfortunately being absent, the response was made, in the first place, by Sir H. Slesser, K.C., and secondly by the Right Hon. Sir Joseph Cook, G.C.M.G., the High Commissioner of the Australian Commonwealth. The toast of "Science," ably introduced by Mr. S. C. Lewis, M. Inst. C.E., called forth an equally able reply from Sir Ernest Rutherford, O.M., the President of the Royal Society. Mr. A. H. Preece, M. Inst. C.E., contrived to weave a great deal of humour into his speech introducing the toast of "Law," to which entertaining replies were made by the Hon. Mr. Justice McCardie and Sir Lyden Macassey, K.B.E., K.C. The final toast—that of "The Association of Consulting Engineers"—was proposed by Mr. W. B. Clode, K.C., who submitted that the engineer was actually the most important person in the world, and was replied to by the chairman.

Railway Matters.

HAVING investigated the travelling facilities to and from North-East London, the London and Home Counties Traffic Committee has, under an Order made by the Minister of Transport under the London Traffic Act, 1924, been appointed to inquire into the travelling facilities to and from East London. Public notice has now been given that the proceedings will be opened on Monday, March 15th.

IN connection with the retirement, as from March 1st, owing to ill-health, of Mr. W. Temple Franks, the Comptroller-General of Patents, Designs and Trade Marks, it may be of interest to know that prior to holding that appointment Mr. Franks was the secretary to the Railway Companies' Association. He succeeded, in 1905, Mr. (now Sir) Guy Granet in that position, when Sir Guy went to the Midland Railway as assistant general manager.

IN reviewing Mr. Raynar Wilson's "Railway Accidents: Legislation and Statistics, 1825 to 1924," the *Economist* made a useful point as illustrating the greater safety of British railways. It showed that in 1874, with 478 million passengers, the amount paid in compensation for personal injuries was £355,900; in 1899, with 1107 million passenger journeys, the amount was £166,000; and in 1924, with 1747 million journeys, it was only £79,400.

WHAT is erroneously called train control, but which, as used on the Metropolitan District and the Tube railways, is essentially traffic control, had been adopted by all the large companies before it found its way on to the Great Eastern. It is now announced that it has been decided to establish a control area based on Cambridge, which will embrace Ely, March, Spalding, Peterborough, St. Ives, Bury St. Edmunds and Bishops Stortford. The cost will be £8000.

IN this column of our issue of July 24th we quoted the chairman of the Southern Railway as saying that the overhead system of electric traction on the Brighton section was to be altered to the third-rail system, as used on the other sections of the Southern Railway. That statement was corroborated at the annual meeting of the company on February 25th, when the chairman said that in due course arrangements would be made for the gradual replacement of the single-phase by the direct-current system.

ON Sunday last electrically operated trains commenced to run between Charing Cross, Cannon-street and Addiscombe and between Elmers End and Hayes, New Beckenham and Beckenham Junction, St. Johns and Orpington and Grove Park and Bromley North. In view of unfortunate incidents that attended some of the previous openings, the company issued an appeal warning the public that new electrical services are always difficult to work for a few days, and that no amount of care can prevent temporary breakdowns with new machinery.

ADDRESSING the shareholders of the London, Midland and Scottish Railway at the annual meeting on February 26th, Sir Guy Granet, the chairman, said that compared with 1922 the company had decreased its annual expenditure by 4 millions. Whilst that is very satisfactory, we might point out that the receipts for the same period also decreased by a similar amount. On the other hand, the receipts of the London and North-Eastern were 7 millions lower in 1925 than in 1922 and that company saved only 3 millions. The Great Western receipts were 3½ millions less and the expenditure 1½ millions less.

IF the average person were told that in 1924 125 passengers were killed and 3190 injured on British railways, he would probably assume that such casualties were the result of railway accidents. That is not the case; only six were killed and 679 injured in train accidents. No less than 85 were killed and 2677 injured by other than train accidents, and of the former figure 21 met their death when getting in or out of trains usually before the train had stopped, and 1051 of the 2677 were injured in that way. It is a satisfaction therefore to hear that a man was fined at Manchester on February 17th for alighting from a train before it had come to rest.

ON page 550 of our issue of November 20th last we mentioned that the London, Midland and Scottish Company was purchasing three Garratt locomotives in order to work its coal trains between Toton and London. Toton Sidings are situated just north of Trent Junction, and there the wagons from the various collieries in the Erewash Valley are collected and made up into complete trains. On the up side are ten reception lines for loaded wagons, each road holding sixty wagons. These are sorted out into twenty-four sidings, with a total capacity of 2000 wagons. On the down side the empty wagons from London and the South are sorted out for the various collieries in one of three marshalling yards, which have accommodation for 1700, 1500 and 1100 wagons respectively.

A SEVERE snowstorm on the night of December 18th–19th was, in part, responsible for the most destructive collision in this country for the last three or so years. The snow obscured the lights of the signals between Edinburgh and Glasgow on the former North British Railway, and the driver of an express failed to see the light of the distant worked from Linlithgow box. That signal was against him, as a goods train was shunting at the station. The engine was one of the "Director" class, but the driver failed to cross from the driving, or right-hand, side of the footplate to see the signal, but said he looked back as he passed it, and the light of the fire showed it to be drooping, so he took it as being at "clear." The fireman could not see the light, but said that, as he approached the signal, he saw the arm hanging down. By what light he saw it he could not explain. The consequence was that the train over-ran the outer and inner home signals, and struck the goods train. The report by Lieut.-Colonel Mount says that the failure of the driver was the result of familiarity, leading to gross carelessness. The remark is made that the collision was a typical example of accident preventable by some system of automatic train control and the suggestion is made that colour light signals, owing to their design, form of construction, high penetrative power and low height, would, in respect of obscuration by snow, be better than semaphore signals, and their use would go far to increase the already high factor of safety in the operation of traffic.

Notes and Memoranda.

IT is claimed that the new Citroën motor car works at Slough will have an output of 1500 cars this year, 30,000 next year and 60,000 in 1928.

DURING 1925 installations aggregating over 719,000 horse-power were added to the generating capacity of Canadian hydro-electric stations, which now totals 4,290,000 horse-power.

THE import trade of Tanganyika Territory during 1925 amounted approximately to £2,443,000. Great Britain supplied 39 per cent., India 17 per cent., Germany 11 per cent., and Holland 9 per cent.

IT is stated in the *Chemiker-Zeitung* that Siemens, Halske and Co. have succeeded in solving the problem of producing pure metallic tantalum in the form of large blocks and sheets of foil, which will be likely to provide most useful material for the manufacture of scientific apparatus.

THE Board of Trade has decided to give candidates for certificates of competency as skipper and holders of such certificates an opportunity of proving that they possess a knowledge of navigation sufficient to enable them to navigate a fishing vessel for long voyages, such as a voyage across the Atlantic.

ACCORDING to the South African Government mining regulations, 1¼in. drill steel has to have a ¾in. axial hole, and ¾in. round or hexagon steel has to have a ⅝in. hole, but Mr. H. S. Potter submits that if a ⅝in. hole is large enough for ¾in. steel, it should be large enough for 1¼in. steel. The result would be a stronger steel, and it will be understood that there is a better chance of filling with water a ⅝in. than a ¾in. hole—that is, a better jet action would be obtained. In Mr. Potter's opinion, therefore, a ⅝in. hole should be made standard on all sizes and diameters of drill steel.

PATENT rights have been granted in America to H. J. Force, of the Delaware, Lackawanna and Western Railroad, for a rail made of steel containing carbon, from 0·30 to 0·85 per cent.; manganese, from 1·15 to 1·90 per cent.; phosphorus, not to exceed 0·05 per cent.; and silicon, not to exceed 0·30 per cent. The inventor claims that the steel will increase the length of the life of the rail, not only as to wear, but also that it will materially reduce disintegration and piping or seamy rails. He also claims that a rail made of this steel will withstand the standard drop test with greater deflection and will show a higher average hardness and stiffer section than the present rail steel.

THE new hoist which has been installed in America by the Woodward Iron Company for its No. 2 ore mines on Red Mountain, is, according to the *Iron and Coal Trades Review*, capable of handling 20 tons of ore each trip. The hoist operates two skips in balance at a speed of 3000ft. per minute on a 30 deg. slope. The drum is of the cylindro-conical type, the cylindrical part being 12ft. diameter and the small end of the conical part 8ft. in diameter. Its overall length is 17ft., and the entire drum has a rope capacity of 3750ft. of 1¼in. rope. The drum shaft is 30ft. long, and has a 6in. hole bored through the centre of its entire length on a gun-boring lathe to facilitate inspection and as a guarantee against defects.

THE Ministry of Health has, according to the *Ironmonger*, been studying the method introduced by the Butterley Company, Ltd., by which the waste heat available at a colliery in Kirkby-in-Ashfield is used to heat water that is supplied direct to ninety-two houses. The water is conducted by copper or steel pipes from a tank that is heated by exhaust steam discharged from the main winding engines. These pipes are taken along the walls of the houses inside, and thus tend to keep the houses warm and the walls free from damp. Radiators can also be fitted to dry damp underclothing. Where 100 houses are built within 1000 yards of the colliery the approximate cost of providing this hot water supply with a sink in the kitchen and the bathroom is £13 10s. for steel piping, and £16 4s. for copper piping. It has been found that the loss of heat on a 1200-yard circulation is very small.

IN summarising a paper on "The Application of American Practice to the British Coke Industry," read before the Cleveland Institution of Engineers, Mr. T. B. Smith said that:—(1) Narrower ovens would give better results with all coals, from the point of quality and product, and longer and higher ovens from the point of output; (2) for good caking coals, present carbonisation temperatures should not be exceeded; (3) for poor caking coals, high carbonisation temperatures should be used; (4) silicia should replace quartzite only when high temperatures are absolutely necessary to produce a good coke from a poor caking coal, or where excessive salt trouble is experienced, in which latter case the carbonisation temperature should depend solely upon the caking power of the coal; (5) the moisture content of the coal should be as low as possible. This, with poor caking coals, however, must be consistent with a good compression; (6) the coal should be in as fine a condition as possible.

THE study of oil production methods with reference to the amount of oil originally present in the oil-bearing formations has developed the fact that ordinary methods of production remove only a part of the oil actually present. In fact, it is generally realised that when a field is abandoned more oil remains in the sand than has ever been removed. As a consequence of this realisation the petroleum engineer has devoted considerable time in recent years in devising methods for increasing the percentage of recovery. His studies have indicated that in most cases the total production of a field is dependent upon the available gas rather than upon the available oil. When the gas in the sand is exhausted oil production ceases even though there may be enormous quantities of oil remaining unrecovered. Consequently, any method of conserving the gas or increasing the supply of gas will increase the ultimate recovery from a field. The practice of producing oil under vacuum increases the effectiveness of the gas remaining in the sand, as well as furnishing more gas by evaporating the light fractions of the crude. Pumping compressed gas or air down selected wells of a lease has been found to increase the production of oil from the surrounding wells.

Miscellanea.

THE output of coal from the mines of Great Britain for the week which ended on February 20th was 5,417,600 tons, as compared with 5,356,900 tons for the corresponding week of last year.

IT is reported from Breslau that an Anglo-American group of financiers is at present negotiating at Warsaw for the acquisition of the Chorzow Electric Works. The intention is to enlarge the works so that they shall be able to supply Polish Upper Silesia, the Dombrova coal district and Cracow industrial undertakings with electric light and power.

AT a recent meeting of Whaley Bridge Urban District Council a letter was read from the Power Development Company, Victoria-street, London, stating that the company intended to apply to the Electricity Commissioners for an order to supply electricity in the rural district of Chapel-en-le-Frith and the urban district of Whaley Bridge. The company stated that it would give an assurance of its ability to carry out the scheme if the order was granted, and asked for the Council's support. The Council decided that it was unable to do anything in the matter, and referred the question to the South-East Lancashire Electricity Advisory Board.

AT a recent meeting of the Rumanian Superior Power Council at the Ministry of Industry and Commerce the Mayor of Bucarest was authorised to install in the town works a 10,000-kilowatt turbo-alternating electric plant which will increase the capacity of the works by 50 per cent. The Council also granted to the mining industry company in the Banat a concession to erect a 30,000-kilowatt thermo-electric works at Boccha-Montana, which is to use exclusively the coal of inferior quality found in the region. Finally the Council granted a concession for the construction of a thermo-hydro-electric station in the Cucheni Commune in the Trei-Scaune department.

IF the Bill now before the Quebec Legislative Assembly is passed it will prohibit the export of hydro-electric power from Canada. The Bill provides that every future sale, lease or grant belonging to the Province, shall contain a clause prohibiting the export of power generated in Quebec to places outside Canada. This clause shall also be embodied in existing contracts and shall apply to all renewals. With a view to ensuring its enforcement, the Bill lays down that every violation of the Act shall render such contract null and void. The Bill does not affect the export of power to other Canadian Provinces. Mr. Taschereau, the Premier of Quebec, is sponsoring the Bill, and its passage is regarded as a foregone conclusion.

THE British Engineers' Association, in its monthly bulletin, states that among the overseas inquiries received and distributed to members of the Association during January, New Zealand's requirements are prominent, and are indicative of the extensive developments being carried out in that Dominion. Electric cables, motors, control gear and accessories are required by the Otago Harbour Board, while 22,000-volt switchgear and equipment, motor generators, storage batteries and accessories, oil filter presses and testing equipment are called for in connection with the Arapuni electric power supply scheme. Steam cranes, a steam shovel and a locomotive are required for harbour developments. Motor generator sets, gear, and equipment are wanted by the Government Railways. Quarrying transport improvements necessitate an additional twenty railway side-tipping wagons, and the Mangaho hydro-electric power development scheme calls for substantial engineering plant, the orders for which will be placed in this country.

THE Federal Government has now granted permission to the State of Rio de Janeiro to construct and operate two new ports, the first at Nictheroy, the commercial capital of the State of Rio de Janeiro, and the other at Angra-dos-Reis. At the latter, the work will include (*a*) the building of a 300 m. pier for docking steamers with a draught of 8 m.; (*b*) the laying of railway lines; (*c*) the construction of warehouses covering 4000 square metres and equipped with electric cranes; and (*d*) the linking up of the Ilha-dos-Coqueiros with the city of Angra by a causeway. A new water supply and an electrical installation for light and power are also included in the concession. At Nictheroy, where the work will be less extensive, a considerable amount of dredging at the entrance to the canal leading to the port will have to be undertaken, and 562 m. of docks will be built for the accommodation of vessels of 8 m. draught, as well as four new warehouses with a total area of 9680 square metres. The laying out of new streets and the installation of water, light and power are also included. The contract for the working of the port is for seventy-five years, during which period the State will collect certain taxes in payment of its expenditure and investment. It is proposed to invite tenders for the construction of the works.

THE laboratories of the mechanical and electrical engineering departments of the University of British Columbia are now nearing completion as regards equipment. It is interesting to note that practically all the equipment thus far supplied is of British make, and includes, in the mechanical laboratory, a 50 brake horse-power Diesel engine; a Froude brake of 50 brake horse-power; a 10-kilowatt De Laval steam turbine connected to a dynamo; a 12 horse-power National gas engine; an 11 horse power Crossley oil engine; a 3-ton refrigerating plant; a 250-kilovolt-ampère alternator and a compound engine of 250 brake horse-power in the power house; and a marine engine of 50 horse-power. In the electrical laboratory the items embrace two direct-current level-compound generators; one rotary converter, three-phase, with transformer and starter; an induction motor; an oscillograph; an alternating-current potentiometer; direct-current potentiometer, galvanometers, condensers, resistances and other standard equipment; electrostatic voltmeters; four transformers; iron-testing equipment; storage battery, 350 ampère-hours, 220 volts; high-tension switchgear panel; switchgear panel and instruments and gear; instruments and current transformers; samples of cables; switches on main panel; and a large number of British text-books replacing American publications.

THE WORKS OF THE CORK MANUFACTURING COMPANY, LTD., AT SOUTH CHINGFORD

(*For description see page 273*)

FIG. 1—BLOCK-MAKING OVENS

FIG. 2—GASKET FINISHING

FIG. 3—PART OF WASHER-MAKING SHOP

FIG. 4—GENERAL VIEW OF TURNING SHOP

AGENTS ABROAD FOR THE SALE OF

The Engineer

BUENOS AIRES.—MITCHELL'S BOOK STORE, 576, Cangallo.
CHINA.—KELLY AND WALSH, Limited, Shanghai and Hong Kong.
EGYPT.—CAIRO EXPRESS AGENCY, near Shepheard's Hotel, Cairo.
FRANCE.—BOYVEAU AND CHEVILLET, Rue de la Banque, Paris.
CHAPELOT AND CIE., 136, Bld. St. Germain, Paris.
BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.
INDIA.—A. I. COMBRIDGE AND CO., Bombay; THACKER AND CO., Limited, Bombay; THACKER, SPINK AND CO., Calcutta.
ITALY.—MAGLIONI AND STRINI, 307, Corso, Rome; FRATELLI TREVES, Corso Umberto I, 174, Rome; FRATELLI BOCCA, Rome; ULRICO HOEPLI, Milan.
JAPAN.—MARUZEN CO., Tokyo and Yokohama.
AFRICA.—WM. DAWSON AND SONS, Limited, 7, Sea-street (Box 49), Capetown.
C. JUTA AND CO., Johannesburg, East London, and Grahamstown.
AUSTRALIA.—GORDON AND GOTCH, Limited, Melbourne, Sydney, Brisbane, and Perth, &c.
MELVILLE AND MULLEN, Melbourne.
ATKINSON AND CO., Gresham-street, Adelaide.
CANADA.—DAWSON, WM., AND SONS, Limited, 87, Queen-street East, Toronto.
GORDON AND GOTCH, Limited, 132, Bay-street, Toronto.
MONTREAL NEWS CO., 386-388, St. James-street, Montreal.
TORONTO NEWS CO., 42, Yonge-street, Toronto.
CEYLON.—WIJAYARTNA AND CO., Colombo.
JAMAICA.—EDUCATIONAL SUPPLY CO., Kingston.
NEW ZEALAND.—GORDON AND GOTCH, Limited, Wellington and Christchurch; UPTON AND CO., Auckland; J. WILSON CRAIG AND CO., Napier.
STRAITS SETTLEMENTS.—KELLY AND WALSH, Limited, Singapore.
UNITED STATES OF AMERICA.—INTERNATIONAL NEWS CO., 83 and 85, Duane-street, New York; SUBSCRIPTION NEWS CO., Chicago.

SUBSCRIPTIONS.

THE ENGINEER can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.

Half-yearly (including index number) .. £1 12s. 6d.
Yearly (including two index numbers) .. £3 5s. 0d.

If credit occur, an extra charge of two shillings and sixpence per annum will be made.

Foreign Subscriptions will be received at the rates given below. Foreign subscribers paying in advance at these rates will receive THE ENGINEER weekly and post free. Subscriptions sent by Post Office Order must be made payable to THE ENGINEER and accompanied by letter of advice to the Publisher.

THIN PAPER COPIES.		THICK PAPER COPIES.	
Half-yearly	£1 11s. 6d.	Half-yearly	£1 13s. 0d.
Yearly	£3 3s. 0d.	Yearly	£3 7s. 6d.

(The difference to cover extra postage.)

Canadian Subscriptions—
Thin paper edition .. .. £2 18s. 6d. per annum.
Thick paper edition .. £3 3s. 0d. ,,

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d each, 5s. 2d. post free.*

ADVERTISEMENTS.

*** The Charge for Situations Open and Wanted Advertisements of four lines and under is four shillings, and one shilling per line for each additional line up to one inch. When an advertisement measures an inch or more the charge is twelve shillings per inch. The rates for all other classes of advertisements, other than those mentioned above, are included in "THE ENGINEER Directory," which is sent post free on application. All single advertisements from the country must be accompanied by a remittance in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.

Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication). ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

"THE METALLURGIST"—BOUND VOLUMES.

Cloth Binding Cases for twelve issues (one year) .. .. 2s. 0d.
Subscribers' own copies, including cases, bound Cloth .. 4s. 0d.
Bound half roan 7s. 6d.

A limited number of Bound Volumes of THE METALLURGIST is available, per volume 12s. 6d.; post free, 13s. 0d.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. 2256, 2257 Central.

PUBLISHER'S NOTICES.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

TO CORRESPONDENTS.

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, March 5th, 1926. PAGE

A SEVEN-DAY JOURNAL .. 259
BRITISH INDUSTRIES FAIR.—No. III. (Illus.) .. 260
NOTES ON BRITISH RAILWAYS BY A CONTINENTAL ENGINEER.—No. V. .. 264
THE MOTOR SHIP DANMARK .. 265
MARINE TURBINE GOVERNING AND FORCED LUBRICATION FAILURE CONTROL. (Illus.) .. 266
THE ACTIVATED SLUDGE PROCESS OF SEWAGE TREATMENT .. 267
A DIESEL-ELECTRIC LOCOMOTIVE. (Illus.) .. 268
MATTHEW MURRAY .. 268
CONTRACTS SECURED BY BRITISH FIRMS .. 268
RAILWAY MATTERS .. 269
NOTES AND MEMORANDA .. 269
MISCELLANEA .. 269
LEADING ARTICLES—
The Navy Estimates .. 271
Too Many Institutions? .. 272
THE CONSISTENCY OF STEAM TABLES .. 272
CORK JOINTING. (Illus.) .. 273
EXTENSIONS TO THE LOTS-ROAD POWER STATION .. 273
SIXTY YEARS AGO .. 273
OIL-FIRED YARROW LAND-TYPE BOILER. (Illus.) .. 275
ELECTRIC PROPULSION OF SHIPS .. 275
BACK BAY RECLAMATION, BOMBAY .. 275
NEW SWING BRIDGE FOR WALLASEY. (Illus.) .. 276
LETTERS TO THE EDITOR—
Cutting Temperatures .. 276
Culture for Engineers .. 277
Whirling Speeds of Drum Rotors .. 277
The Training of Engineers .. 277
DIESEL ENGINE USERS' ASSOCIATION .. 277
AN IMPROVED AUTOMATIC LATHE. (Illus.) .. 278
SOUTH AFRICAN ENGINEERING NOTES .. 278
CONTRACTS .. 278
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 279
Lancashire .. 279
Sheffield .. 280
North of England .. 280
Scotland .. 281
Wales and Adjoining Counties .. 281
CURRENT PRICES FOR METALS AND FUELS .. 282
FRENCH ENGINEERING NOTES .. 283
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 283
FORTHCOMING ENGAGEMENTS .. 284

DEATH.

On February 26th, at Oakhill, Moortown, Leeds, LAWRENCE CLAYTON, chairman of Clayton, Son and Co., Ltd., Moor End Works, Hunslet, Leeds.

THE ENGINEER.

MARCH 5, 1926.

The Navy Estimates.

THE Navy Estimates for 1926–27, as foreshadowed in a statement by the First Lord of the Admiralty, contemplate a net outlay of £58,100,000, which is £2,400,100 below the Estimates for the financial year now drawing to a close. By a rigorous pruning of expenditure in the administrative branches of the service and in the maintenance charges of shore and floating establishments, the Admiralty has been able to effect a saving of more than £5,000,000; but since half this sum is set aside for the new construction to be put in hand during the coming year, the actual amount saved is approximately two and a half million. It will be seen therefore that the Admiralty has carried out the pledge it gave last summer, when, in return for parliamentary approval of the five-year shipbuilding programme, it undertook to curtail the general cost of the Navy by every means possible. Drastic measures were necessary to fulfil that pledge. The fleets in the Mediterranean and home waters have been reduced. By the end of this month the Mediterranean command will include only six battleships, instead of the eight of which it has hitherto consisted. Four ships of the "Iron Duke" class are coming home to form a training squadron for boys. Nominally they will be part of the Atlantic Fleet, but in view of the duty to which they have been assigned their presence will add little to the war-readiness of that fleet. Their place in the Mediterreanan is to be taken by two ships of the "Royal Sovereign" class. Admiral Sir Roger Keyes will thus have six battleships armed with 15in. guns, but having regard to the 4 knots disparity in speed between the "Queen Elizabeths" and the "Royal Sovereigns," his fleet is not so homogeneous as could be wished. Four well-known battleships are to be discarded in the near future under the terms of the Washington Treaty. The King George V., Centurion and Thunderer will be disposed of to shipbreakers, but the Ajax is to be retained as a fleet target ship in place of the Agamemnon. The removal of these vessels from the active list is rendered necessary by the approaching completion of the Nelson and Rodney. Further economies are made possible by the scrapping of three cruisers, thirty-four destroyers, and five depôt ships, and by the closing of Rosyth and Pembroke dockyards.

That establishments and ships which have clearly outlived their utility should be written off is all to the good, but while there can be no rational objection to the closing of redundant dockyards, naval opinion is opposed to the ruthless condemnation of ships which are still good for years of effective service. We understand that many of the destroyers now on the condemned list are still sound in machinery and structure, and could be made thoroughly serviceable by the re-tubing of their boilers. It is to be regretted that, in the absence of funds for this work, so many useful craft should be lost to the Navy. Provision is made in the Estimates for the following new construction:—Two "A" class cruisers of the "County" series, displacing 10,000 tons; one "B" class cruiser of 8000 tons; six "O" class submarines, probably similar to the O 1, of 1345 tons, now in hand at Chatham; one submarine depôt ship; one repair ship; and four motor launches. These vessels form the second year's instalment of the quinquennial building programme introduced last July, which provides for a total of eighty-one units, plus a floating dock, at an estimated cost of £58,000,000. According to official figures, the two "A" class cruisers to be laid down in 1926 will cost together £4,000,000; the "B" cruiser is likely to cost £1,750,000; the six submarines, priced at £400,000 each, will absorb £2,400,000; while the two auxiliary vessels and the four motor launches can hardly be built for less than £450,000. At a conservative estimate, therefore, the building and completion of the vessels provided for in the new naval budget will represent a total charge of £8,600,000, or about £3,500,000 more than the sum which administrative and other economies are expected to save during 1926–27. These figures make it plain that the savings which the Admiralty hopes to achieve in other departments of the service are not sufficient to balance the cost of new construction, and since a halt must soon be called to the deletion of ships and the reduction of the commissioned fleet—the two measures which appear to be mainly responsible for the saving of £5,000,000—it is to be feared that the Navy Estimates for 1927–28 and succeeding years will be considerably higher than those now submitted. From 1926–27 to 1929–30 inclusive, an aggregate sum of £46,000,000 is to be spent on new construction, while an additional sum of £12,000,000 will be required to complete all the vessels laid down during this period. Unless the financial significance of our new, and very necessary, shipbuilding programme is clearly understood beforehand, the Admiralty must be prepared to encounter a great deal of uninformed criticism on the score of its "profligate expenditure" and "broken pledges." The essential facts to be borne in mind are that from the present year to 1932 we shall be spending an average of £8,000,000 a year on new construction, and that there is little prospect of this annual charge being defrayed by corresponding retrenchment in other Navy Votes. Of ships built under the war programme, the cruisers Effingham, Emerald, and Enterprise, the flotilla leader Keppel, and the submarine L 27, will have passed into commission by the end of this month. The cost of these vessels has been greatly increased by their slow rate of construction. The submarine cruiser X 1 is also due to be commissioned before March 31st. As she was laid down on November 2nd, 1921, she has taken fifty-three months to complete, but the delay is understood to have been caused by the exhaustive nature of the trials which were considered necessary in view of the experimental nature of the design. By the time she joins the Fleet this huge submarine will have cost the country £950,000. Of ships distinct from the five-year programme, there remain to be completed the cruiser-minelayer Adventure, the destroyers Amazon and Ambuscade, and submarines L 26 and O 1. As no date for the completion of the Nelson and Rodney is given in the First Lord's statement, these battleships will apparently not be ready for service until the financial year 1927–28. Pending the publication of the Estimates, no information is available as to the progress of work on the new fleet base at Singapore. The original intention was to recondition one of the ex-German floating docks for use at Singapore, but this having been found impracticable a new dock is to be ordered. A considerable amount of ship reconstruction has been undertaken during the past year. The Warspite will soon emerge from dockyard hands fitted with bulges, and her sister ship Valiant is to be similarly equipped. The battle-cruiser Renown, which has been re-armoured and otherwise renovated, is to be completed this year. Further progress is to be made with the reconstruction of the Courageous and Glorious as aircraft

carriers. By the Admiralty's decision to scrap the least efficient of the cruisers and destroyers, the original programme of re-tubing work on these vessels has been substantially diminished. Provision is made for continuing the modernisation of electric generating stations in the Royal dockyards and shore establishments, for the equipment of a steel foundry at Portsmouth, and for supplying machinery of the latest pattern to the dockyards.

Naval aviation and general fleet training form the subject of interesting notes in the First Lord's statement. There are now seventy naval and marine officers employed as pilots, and forty-two are still under training. In future, all executive officers are to undergo a short course in elementary naval aeronautics in an aircraft carrier, either as midshipmen or junior commissioned officers. It is hoped in this way to increase the interest taken by young officers in the work of the Navy's air service. "All R.A.F. aircraft hands for general duties in the Fleet Air Arm have been replaced by R.N. ratings. These substitutions have resulted in economies in that they have enabled the total complement of aircraft carriers to be substantially reduced, since the naval ratings are available for and capable of undertaking ship duties which the replaced airmen were not trained to perform. . . . Steady progress in the use of aircraft by the Fleet is indicated in reports received from sea." Throughout the year gunnery and torpedo practices have been conducted on advanced principles, the object being to evolve methods of meeting every tactical situation. A marked improvement in fire discipline is noted. Anti-aircraft gunnery continues to receive special attention, and good results are anticipated when the new material now on order is supplied. Satisfactory progress is reported in the development of measures against submarines. The *personnel* of the Fleet is to remain at the same total as last year, viz., 102,675, from which number—thanks to the withdrawal of older ships—it will be possible to provide crews for all new construction up to and including the 1925 programme. As a minor measure of economy, the Special Reserve of Engineer Officers is to be discontinued on its present basis, but the Reserve will be retained on a non-training basis. No reference is made by the First Lord to the Admiralty's singular treatment of engineer officers of the Navy, who for reasons still unexplained have been summarily deprived of their combatant status. We know, however, that the last has not been heard of this arbitrary and uncalled-for treatment of a devoted body of naval officers, and that the great institutions which have taken the matter up are continuing their efforts to get engineer officers fully reinstated.

Too Many Institutions?

The movement now afoot to establish an Institute of Fuel Technology seems likely to add another to the list of institutes and institutions which deal with various aspects of technical work, and the question naturally presents itself, not only whether there is a real need for the establishment of this particular Institute, but whether there are not already too many of these bodies in existence, and whether real advantage could not be gained rather by reducing the number and improving their strength and quality, than by creating fresh bodies intended to deal with highly specialised departments. It is, of course, easy enough to see how the desire for the formation of these specialised institutes or societies arises. A particular branch of technology, which has up to a certain time been regarded as a part of the field covered by the activities of an existing Institute begins to "feel its feet," and, with a growing sense of importance, there comes first the impression that this particular branch does not receive adequate attention from the existing institute, and, then, the desire for independence and for securing a more impressive representative organisation for those who are concerned with this particular branch of work. In some cases, too, there is the circumstance that the special field of work considered is covered in part by the activities of a number of existing institutes, but is not fully represented in any of them. This would seem to be the case in regard to fuel technology. One section of this subject is covered by the Iron and Steel Institute, another by the Institute of Petroleum Technologists, while others fall within the fields of a number of other existing bodies. Here there may be a sound case for the creation of a new representative body for the purpose of securing the proper status of those who work on this subject, and particularly for bringing into one focus the very diversified uses of fuel, for it must be remembered that the problem is the same for all, for the glass melter as for the steel maker, for the gas maker as for the boiler user.

It would seem, however, that while more or less good cases can be made out for most of the institutes which exist or are projected, the final result is the multiplication of institutes to an extent which undoubtedly is undesirable, and even injurious to the best interest of technology. The greater the number of institutes, the smaller must be, on the average, the power, influence and financial resources of each, and the more difficult must it become to secure the full weight of joint action in any matter which may concern engineers and technologists in general. The importance of this aspect of the matter must not be underrated, particularly in regard to the future. The value and effectiveness of organisation has made itself felt most strongly during recent years in regard to labour and the need for strong organisation on the part of those who provide the essential knowledge and technical skill required by industry is at least equally important. We do not wish to suggest even remotely that anything in the nature of "trade union methods" should be contemplated by technical institutions or associations. All we wish to suggest is that organisations which can stand for and speak for the technologists and engineers as a whole are of immense importance in determining the future status of those who follow these professions. If we prefer the analogy we can find it in another direction in the great professional organisations which stand for the legal and the medical professions respectively. Engineers, metallurgists and technologists generally possess no such organisation and the splitting of activities and resources into an increasing number of separate institutes tends to make it more and more difficult to set up anything of the nature of a single representative body. The whole body of the technological professions, speaking and acting together through an adequate organisation, would carry at least as much weight and be capable of exerting at least as great an influence on public affairs as that which is now wielded by the legal profession. In view of the ever-increasing technicality of every-day life and of many phases of national life, such an influence is eminently to be desired.

We are faced here with a dilemma. On the one hand the immediate interests of each branch of technology appear to require the support and facilities which can be gained from a specialised body or institute; professional interests as a whole, on the other hand, as well as considerations of economy and efficiency, strongly suggest the desirability of concentrated effort rather than dissipation by excessive specialisation. But is there not an almost obvious remedy? Actual amalgamation of all existing technical institutes into a single body is, no doubt, too much to hope for, nor would it be without many and serious disadvantages. But, short of actual amalgamation, are there not possibilities of something of the nature of affiliation either to an existing institution or to a new organisation to be specially created for the purpose? The numerous sectional institutes would still render their special services to their own members and to the industries with which they are associated, but—through their relation to the central body with which they would then be affiliated—they could render to their professional members, at all events, and possibly also to their industrial members where these exist, a class of service which individual institutes can scarcely attempt. The whole status and prestige of the smaller institutes would be immensely raised by such an affiliation scheme, while even the largest and greatest of our existing institutions could not fail to gain in strength and authority if it found itself—as it might and should—the strongest member of a vastly more powerful combination. There are, of course, many obvious difficulties of organisation to be solved, and many difficulties arising from traditions and from minor jealousies to be overcome before such an affiliation scheme could be brought into existence. The engineer and the technologist of to-day, however, is often essentially an organiser, and among them we could surely find a group of men with sufficient skill and public spirit to carry through a difficult scheme of this kind, to the great benefit of the nation in general, and, in particular, of all those who apply "the forces of nature to the use and advantage of man."

During the past year the mileage of concrete roads in Missouri was nearly doubled—430 miles having been added to the 450 miles already in service.

The Consistency of Steam Tables.

The ordinary engineer looks upon a set of steam tables much as he does upon a table of logarithms; that is, as a collection of figures already calculated for him to aid him in his computations. How the columns of figures have been arrived at he will in general neither know nor care, feeling confident that they would never have been published if they were not trustworthy. If he compares one table of logarithms with another he will always find that the authors agree, but if he makes a corresponding comparison between the various steam tables he will not note the same unanimity. This is sufficiently annoying, as no two calculations concerning steam are likely to be in exact agreement unless the same tables are used; but it is much worse to find that a calculation made in two different ways, using figures from the same book of tables, may show two different results. If a man discovered that the sum of the logarithms of 3 and 4, for example, were different from the sum of the logarithms of 6 and 2, he would for ever mistrust his logarithmic tables. There is fortunately no chance of such a discovery in connection with tables of logarithms, but all steam tables have not yet arrived at such a state of perfection that they will stand a corresponding test in self-consistency. The formulas by which various properties of steam have been computed are empirical, and although they may represent the particular observations on which they are based with great accuracy, they fail in general to meet a necessary condition first pointed out by Callendar. He reminded engineers as long ago as 1900 that as a consequence of thermo-dynamic principles the specific volume of steam was closely connected with its thermal properties, and that this connection must be taken account of in tabulating the properties.

As an illustration of this relationship one may take the case of an engine working between given limits of pressure and temperature. It is obvious that the work done in the cycle must be the same whether it is computed in heat units by the temperature-entropy chart or in mechanical units by the pressure volume diagram. Mr. H. M. Martin showed several years ago that the well-known Marks and Davis tables failed to stand this test, and the fact can be, of course, easily verified by anyone who cares to take the trouble. This is greatly to be regretted, as the tables are unsurpassed for convenience and completeness. Even these qualifications, however, are neutralised by the incredulity which necessarily arises when one can get two different answers to the same sum, according to how the tables are employed. No such fundamental defect, of course, exists in Callendar's own tables, which are adopted as standard by British engineers.

In *Mechanical Engineering* for February, 1926, there is published a report by Mr. J. H. Keenan, giving a great deal of interesting information with regard to the progress of the A.S.M.E. steam research programme. Nearly the whole of three pages is devoted to a table giving the specific volumes of saturated steam at pressures from 1 lb. to 1200 lb. absolute and at superheats up to 400 deg. Fah. As an example of the way in which the new specific volumes differ from those of Marks and Davis and of Callendar we extract a few typical figures from the respective tables.

J. H. Keenan.

Absolute pressure, lb. per sq. in.	Saturated temperature, deg. Fah.	Specific volume at various superheats.		
		0 deg.	100 deg.	200 deg.
1	101·8	333·0	393·9	453·7
100	327·8	4·429	5·11	5·77
200	381·9	2·287	2·667	2·999
300	417·5	1·544	1·812	2·047
400	444·8	1·162	1·374	1·558

Marks and Davis.

Absolute pressure, lb. per sq. in.	Saturated temperature, deg. Fah.	Specific volume at various superheats.		
		0 deg.	100 deg.	200 deg.
1	101·8	333·0	393·9	453·7
100	327·8	4·43	5·14	5·80
200	381·9	2·29	2·68	3·04
300	417·5	1·55	1·83	2·09
400	444·8	1·17	1·40	1·60

Callendar.

Absolute pressure, lb. per sq. in.	Saturated temperature, deg. Fah.	Specific volume at various superheats.		
		0 deg.	100 deg.	200 deg.
1	101·7	333·0	392·9	452·4
100	327·7	4·451	5·126	5·771
200	381·8	2·320	2·679	3·016
300	417·8	1·583	1·834	2·063
400	445·5	1·206	1·401	1·578

It will be noted that there is no appreciable difference in the temperatures of saturated steam at various pressures according to the three tables, nor is there much disagreement as to the specific volume of steam

at very low pressures and various superheats. At the higher pressures the specific volumes given by Callendar are the greatest, and those by Keenan the lowest. The necessity of thermodynamic consistency has been recognised by Mr. Keenan, who has checked his results by the Clapeyron relationship. This is another form of test to which all accurate steam tables must conform. The Clapeyron equation, which is deduced directly from thermodynamic considerations, states that the volume of 1 lb. of saturated steam minus the volume of the water from which it was derived is equal to the latent heat multiplied by Joule's equivalent and by the rate of increase of temperature with regard to pressure, and divided by the absolute temperature. The values of the latent heat used in the equation were derived from the heats of the liquid as tabulated by Goodenough and from the newly determined values of the total heat. The values finally decided on for the new specific volumes differed from those obtained from the Clapeyron equation by a maximum of ·36 per cent.

In addition to the table to which we have referred, Mr. Keenan's report contains two Mollier diagrams, one going up to a pressure of 750 lb. and the other, computed by extrapolation methods, extending from 300 lb. to 1200 lb. As in the case of other American charts of this nature, the scales and the ruling have been chosen with an eye to the greatest convenience of the user, the heat scale being one millimetre per B.Th.U. and the adiabatic lines being one millimetre apart. For the preparation of the charts data below 320 deg. Fah. have been taken from Marks and Davis tables, and data above this temperature from recent experiments by Messrs. Davis and Kleinschmidt. It would be an advantage to English engineers if someone would publish an equally attractive Mollier diagram, based on Callendar's tables, as these, owing to their self-consistency and accuracy, are much to be preferred to any of their rivals, even though they may not be so conveniently arranged.

Cork Jointing.

WE have recently described the process of converting cork together with an oily binder, into linoleum, and it thus seems only appropriate that we should give some account of a method by means of which cork can be converted into a material of more immediate interest to engineers, that is to say, jointing or gaskets. With this object in view, we paid a visit to the factory, in South Chingford, of the Cork Manufacturing Company, Ltd., which, by the way, is close alongside the new arterial road, and thus, before very long, should be well situated as regards transport facilities. Some illustrations of the interior of the works are given on page 270.

The material made by the company is only similar to linloeum in so far that its principal ingredient is ground cork, while some grades have a resilience comparable with that of corticene; but no oil is used in its manufacture, and the process of preparation is much more simple than is that of linoleum. The material feels and looks just like granulated cork held together by some impalpable binder and can be used for a great variety of mechanical purposes, besides being very useful in sport and for domestic requirements. A brief account of the method of preparation will, however give a better impression of the characteristics of the material than can any attempt at a verbal picture. It has been given the name of "Langite."

The principal raw material, is, as we have said, cork, and it is generally in the form of cork stoppers rejected by bottling firms. Such cork is naturally of a good quality, as the cork-making people only use the better brands; but the corks may be rejected for bottling on account of defects which will have no significance when they are broken up.

The corks are fed in small quantities, so that the attendant can look out for any foreign matter, into a "Devil" pulveriser, which comprises a disc with projecting teeth on the face that run between the teeth of a corresponding disc. The cork discharged from this mill is a little smaller than ordinary peas, and is elevated to the top of the building, where it is passed over a jigging screen. The screen has a very fine mesh and allows any dust to fall through, while the larger material goes forward to another set of devils. These machines reduce the cork to about the consistency of oatmeal, but naturally produce several different sizes of grain. It is important in the manufacture of "Langite" that the size of the particles shall be reasonably consistent, and that the mass shall contain no dust. So the product of the mills is sent down an inclined shoot fitted with several partitions of wire mesh, and three different grades of cork are delivered at the bottom. Incidentally, any dirt, which is appreciably heavier than the cork, falls right through the screen and is collected separately. Finally, the cork is taken, one grade at a time, to a machine very similar to a flour dresser and is sifted to ensure that it contains no dust or dirt. It is noteworthy that the proportion of dust produced in this process is comparatively small, but such as is made finds a market among the makers of linoleum.

The cork is now ready for incorporation with the binding medium, and although we are not at liberty to disclose the exact nature of the binder, we may mention that the separate constituents are carefully weighed out for every batch. The cork and the binder are thoroughly mixed together in an ordinary pug mill, of much the same type as that used in the paint trade, and the mass is then taken to a press, shown in the engraving, Fig. 1.

In this press the material is squeezed down to about one-third of its original volume in boxes made of perforated steel plate, several of which are shown in the foreground of the illustration. Lids are clamped on the boxes by means of stretchers, and they are transferred to the ovens on the left. Here they are subjected to the patented "Langite" process, where great care is taken to produce absolutely uniform blocks. These blocks are, by the way, of a standard size, 3ft. by 2ft. by 4½in. The blocks are then taken to a steam-heated store room and are left to mature for at least a week. During that time they re-absorb some moisture, but, after being taken out of the hot store, are left exposed in the open shop as long as is possible to become normalised or seasoned. The longer the blocks are left to season, the less likely, obviously, is any article subsequently cut from the block to change its shape.

On account of the perforations in the box plates the blocks of cork have at this stage a "pimply" surface, and they are not truly flat as the plates give somewhat under the pressure. They are consequently taken to a machine, in which they are skimmed flat by means of a horizontal knife. The knife is set at the proper distance above a table, and is given a rapid reciprocating motion through a crank and connecting-rod. The block is then fed under the knife by a set of feed rolls, and a very clean cut is made right across the surface. The scrap produced during this operation is re-milled, and is used again for such purposes as making composition cricket balls. In the same machine the blocks can, of course, be sliced up into thin sheets, and pieces as thin as $^1/_{32}$in. can be readily cut, while the knife will cut down to within ¼in. of the table.

These sheets have a remarkable resilience and considerable tensile strength, but for some purposes it is necessary that they should be reinforced. In such cases two sheets of cork are cemented together with an interleaf of thin fabric and the composite sheet is left to set under a heavy press. These sheets can be doubled backwards and forwards without the cork separating from the reinforcement, and provide an excellent material for making gaskets or washers. In the case of comparatively small gaskets, they are cut out of a complete sheet; but for larger sizes they are built up of strips and corner pieces, scarphed together. In Fig. 2 we give a view in the gasket-finishing room.

The makers claim for this material that it is superior to any other resilient substance for all-round service in making fluid-tight joints, except where a temperature above 220 deg. Fah. has to be withstood, and, so far as some rough experiments we have made indicate, we are inclined to agree with this contention. It has also been proved most efficient for vacuum joints. We have tried the jointing with boiling water, lubricating oil, both hot and cold, paraffin, amyl-acetate, turpentine, and a mixture of acetone and spirit. None of these substances affected the bond or penetrated the material at atmospheric pressure. The jointing also has a remarkable ability to recover from compression, and it should be possible to use gaskets made of it several times over.

Plain washers can be readily made from the simple sheet to act, for instance, as oil-tight rings on bearings or packings in the stern glands of propeller shafts, and the company makes vast numbers of various sizes. The sheet is first cut into discs and then the discs are mounted in a bell chuck in the lathe, so that the interior may be cut out with a parting tool. The chuck is made of the cork material, and gives just enough grip to withstand the cut without distorting the washer. It is, we understand, possible to stamp out the sheets by a shearing action, and such a process may be used where the quantity of any one article justifies the outlay, but at Chingford such a wide variety of patterns is dealt with, that most of the articles are cut out individually. Fig. 3 shows some of the lathes used for washer making, while the two block presses can be seen in the background.

Another useful application of the material is in the manufacture of floats for carburetters, ball cocks, &c For this purpose it is roughed out into blocks by a band saw. The block is pierced through the centre by means of a sharp-edged rotating tube, and is then mounted between the centres of a machine. On the top of a vertical spindle there is a thin steel disc, about a yard in diameter, with a very sharp edge. This edge is maintained by a little grinding wheel, set at a slight angle, so that the drag of the disc keeps it rotating. Facing the opposite sides of the disc there are two little lathes, between the centres of which the object to be turned is clamped, by means of a quick-release gear. The whole lathe is then advanced towards the rotating disc, against an adjustable stop, and the job is very quickly reduced to the proper diameter. This machine is, of course, only suitable for comparatively short pieces.

It is hardly necessary here to enlarge on other uses of the material, as it will be obvious to engineers that it is suitable for the absorption of vibration, the insulation of cold chambers and many other purposes, while it finds large application in household and domestic service. It can be made in several different grades of hardness and density, but is generally manufactured in three standards, of which the lightest weighs about 18 lb. per cubic foot, while the heaviest weighs some 27 lb. per cubic foot.

EXTENSIONS TO THE LOTS ROAD POWER STATION.

THE operation of the extension of the Tube Railway from Charing Cross to Kennington will make further demands on the Lots-road power station at Chelsea, and, in consequence of it, and of other transport facilities which are to be provided in the future, the generating plant is being augmented accordingly.

The Chelsea power station is one of the largest in the country, and at the present time it contains generating equipment comprising seven turbo-alternators of 6000 kilowatts each, and three of 15,000 kilowatts each, the total generating capacity being therefore 87,000 kilowatts, which is equivalent to over 116,000 horse-power. At the present time a fourth 15,000-kilowatt machine is under construction, and when it has been put into service the generating capacity of the power station will be 102,000 kilowatts, or nearly 137,000 horse-power.

The steam generating plant comprises sixty-four boilers, each being designed to produce 16,000 lb. of steam per hour at a pressure of about 200 lb. to the square inch, and also eight boilers, each having a capacity of 40,000 lb. per hour. Two further boilers having a capacity of about 50,000 lb. per hour are under construction and will be in operation during the present year.

The present maximum load on the power station is about 70,000 kilowatts, or approximately 94,000 horse-power, and it is estimated that in five years' time the total demand will be about 100,000 kilowatts, or 134,000 horse-power. To provide for this additional load further large turbo-alternators, which will each have a capacity of 15,000 kilowatts, will be installed in place of the existing machines of 6000 kilowatts capacity, and further boilers of 50,000 lb. per hour each will be substituted for the existing boilers of 16,000 lb. per hour each. All the new turbines have been designed so that they can, at a later date, operate with steam at a pressure of 275 lb. per square inch, at which pressure all the new boilers will be capable of working. By operating at the higher steam pressure very considerable reductions in coal consumption will be effected.

SIXTY YEARS AGO.

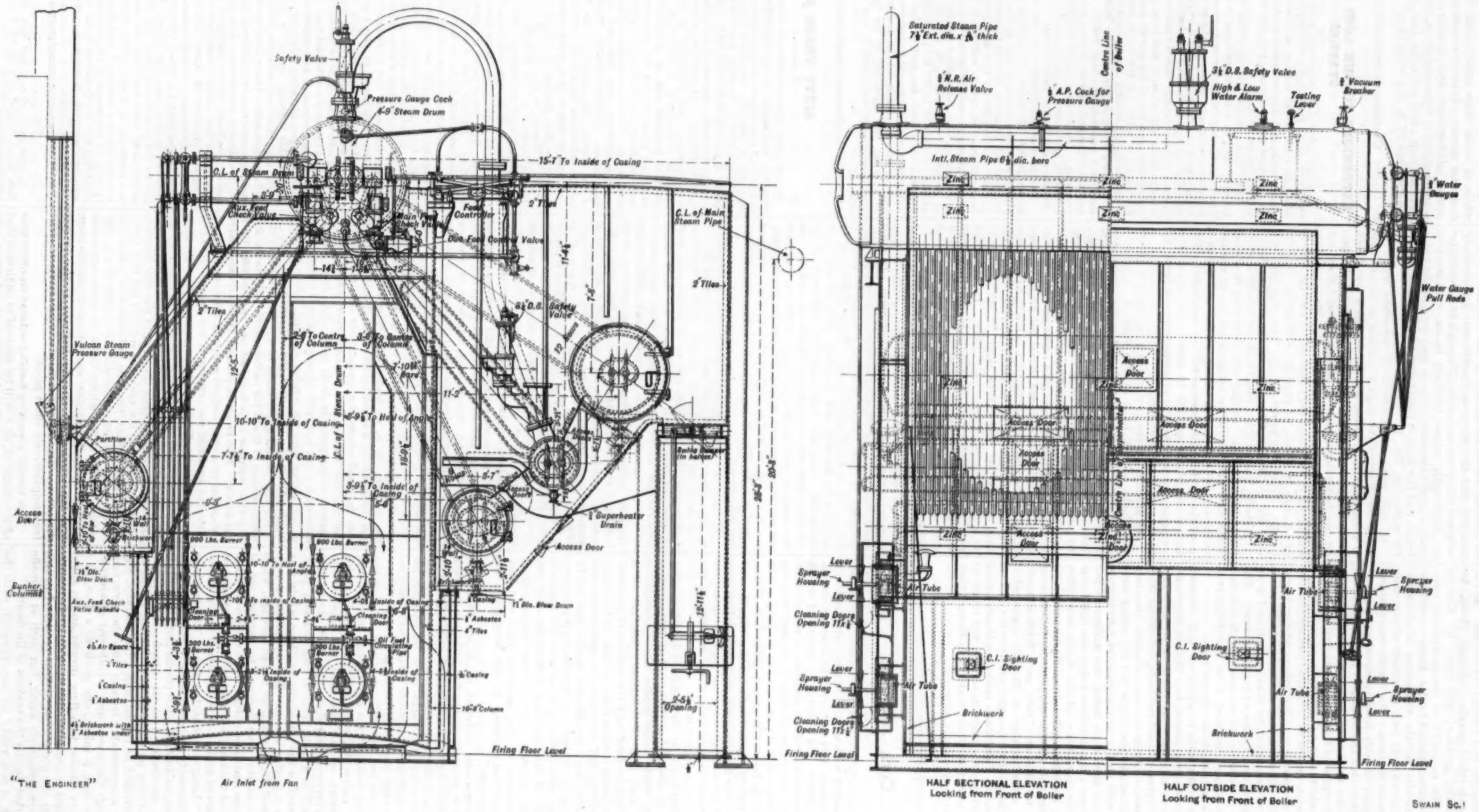
SIXTY years ago Government interference in the construction and equipment of steamships formed a constant subject for resentment and criticism. The Steam Navigation Act of 1846, the first piece of legislation affecting the construction of steamships, governed the situation up to 1862. It and those Acts passed to supplement or amend it were particularly concerned with the provision of water-tight bulkheads. The official requirements in this connection were, it was contended by many shipbuilding and shipping authorities, mischievous, and such as would actually promote loss of property and life. Only for passenger steamers did the Acts require a survey to be made to determine whether the provisions had been duly attended to. For cargo vessels, although the Acts specified equal subdivision, the bulkhead clause soon became a dead letter. According to Mr. Thomas Gray, an officer of the Marine Department of the Board of Trade, in a lecture before the Society of Arts, which we reprinted in our issue of March 2nd, 1866, water-tight bulkheads in ships were first applied in this country in 1835 by Mr. C. W. Williams in the City of Dublin Company's iron steamer Garryowen. Mr. Williams appears to have studied the question very thoroughly. In a paper which he read before the British Association in September, 1837, he showed that nothing less than four bulkheads dividing a ship into five water-tight compartments could ensure her safety. By that year seven vessels had already been equipped with bulkheads on his plan. Yet when Parliament moved in the matter in 1846 it was content to specify the employment of but two bulkheads, one forward and one aft of the engine-room. With the advent of screw steamers, in which the engine-room was placed right aft, the requirements became ridiculous, and the letter of the Acts was frequently met by the construction of flimsy and inexpensive bulkheads in the legal position. In 1854 the Merchant Shipping Act, while still specifying the use of but two bulkheads, required that they should divide the hull into three equal or nearly equal parts, and be as strong as the ship's side plating. In 1862 the bulkhead clauses were repealed, and shipbuilders and owners were allowed to provide what bulkheads they deemed necessary or desirable without legislative interference. Mr. Gray urged that other requirements of the Acts still remaining in force governing the provision of boats and lifebuoys and the control of safety valves on marine boilers demanded no less drastic treatment. The number of boats to be carried was based on the tonnage of the vessel, irrespective of whether she carried passengers or cargo. From some examples given by Mr. Gray it would appear that in fulfilment of the Acts a cargo steamer was compelled to provide one boat for every four or five members of the crew, while on a passenger vessel the allowance was from 250 to 300 people to a boat. By 1866 the official requirements as to boats had, like the bulkhead clause, become to a great extent of no account, and it was urged that they, too, should be abandoned, and the question of safety left entirely in the hands of the owners. Mr. Gray's remarks regarding the requirements in the matter of safety valves were of a similarly destructive order.

A NEW seam of coal has been discovered near Dubbo, New South Wales, at a depth of about 90ft. It is of the bituminous type.

OIL-FIRED, LAND-TYPE WATER-TUBE BOILER

YARROW AND CO. (1922), LTD., SCOTSTOUN, GLASGOW, ENGINEERS

(*For description see opposite page*)



"THE ENGINEER"

HALF SECTIONAL ELEVATION
Looking from Front of Boiler

HALF OUTSIDE ELEVATION
Looking from Front of Boiler

SWAIN Sc.

Oil-fired Yarrow Land-Type Boiler.

WE have pleasure in giving particulars of the two boilers which were supplied by Yarrow and Co. (1922), Ltd., for the Ferguslie Mills, Paisley, of J. and P. Coats, Ltd. These boilers are of interest as they are among the first Yarrow land type boilers of the single gas flow type to be equipped for oil burning.

The general disposition of the boiler can be seen from the drawing on page 274. It consists essentially of one steam drum, three water drums and one superheater drum. The special feature in this design is that the front water drum is connected to the steam drum by four rows of generating tubes, which act as a water screen and form valuable heating surface, being subject to direct radiation from the furnace, although no gases pass through this nest of tubes. It will be noticed that this design of boiler with its two banks or nests of tubes bordering on the furnace approaches designs in which special water screens are added, but in this case the water screen forms an integral part of the boiler itself. The superheater is placed at the back of the boiler screened by a bank of six rows of boiler tubes, and has a further bank of generating tubes, twelve rows wide, between it and the flue, this part of the boiler being the Yarrow standard land type.

The principal particulars are as follows :—

Generating heating surface	7016 sq. feet
Superheating surface	2005 sq. feet
Combustion chamber volume	2790 cubic feet

The vertical flue is right at the back of the boiler, and leads to a common underground flue and a high brick chimney. Forced draught is provided by a fan in the basement. The air enters the double casing under the bottom of the furnace, and passes through double casings over the whole of the outside of the furnace on its way to the oil burners, situated as shown, at each side of the boiler.

The oil-burning equipment is of the Yarrow improved type.

The results of the official trials at normal load on one of these boilers are as follows :—

Water evaporated per hour, actual	41,252 lb.
Water evaporated per hour, from and at 212 deg. Fah.	53,600 lb.
Steam pressure	258 lb./sq. inch
Steam temperature	638 deg. Fah.
Feed temperature	102
Water evaporated per pound of fuel, actual	11·9
Water evaporated per pound of fuel, from and at 212 deg. Fah.	15·49
CO_2 in flue gases	13·8
Calorific value of fuel	17,913 B.Th.U./lb.
Efficiency	83·8 per cent.
Guaranteed evaporation from and at 212 deg. Fah, excluding superheat, normal	45,000 lb.
Ditto, overload	56,250 lb.
Guaranteed efficiency at normal load	81 per cent.

The guaranteed efficiency was for boiler and superheater only, there being no economiser or air heater at the time these tests were made. Since then an air heater of the Yarrow type has been fitted in the vertical flue, and from trials run it is found that it has increased the efficiency by approximately 5 per cent. The following readings were taken :—

Evaporation of boiler	40,000 lb./hour
Temperature of air entering heater	110 deg. Fah.
Temperature of air leaving heater	240 deg. Fah.
Rise in temperature of air	130 deg. Fah.
Temperature of gas entering air heater	556 deg. Fah.
Temperature of gas leaving air heater	435 deg. Fah.
Drop in temperature of gas	121 deg. Fah.
Suction draught before air heater	$^{9}/_{16}$in.
Suction draught after air heater	$\frac{3}{8}$in.
Air pressure before heater	6
Air suction after heater	1$\frac{1}{4}$in.

NOTE.—The furnace temperature by optical pyrometer (radiation type) was 2530 deg. Fah.

One of the points which received the careful consideration of the designers was flexibility. The load at the Ferguslie Works of J. and P. Coats, Ltd., increases from practically nothing to a maximum in about three minutes, and is as suddenly cut off at mid-day meal times, and again in the afternoon. By adopting thin brickwork, double air casings and oil fuel firing, this quick variation of load is met satisfactorily.

Electric Propulsion of Ships.

ON Friday, February 12th, Mr. Eskil Berg, of the American General Electric Company, read a paper before the North-East Coast Institution of Engineers and Shipbuilders on "The Electric Propulsion of Ships." The paper deals largely with the application of the turbo-electric drive to a high powered passenger vessel, and gives steam consumptions, electrical losses and weights for the equipment of a ship of 17,000 shaft horse-power. It also deals in a general way with the electric drive and compares it with the geared drive.

Recently, the author states, the International Mercantile Marine has closed a contract with the Newport News Shipbuilding Company for an electrically-driven twin-screw liner of 17,000 horse-power. The propelling machinery is to be built by the General Electric Company, of America.

The dimensions and other particulars of the ship are as follows :—Length, 600ft.; beam, 80ft.; draught, 30ft.; displacement, 22,000 tons; propeller speed, 120 revolutions per minute; horse-power, 17,000; speed, 18 knots; propellers, 18ft. 6in. diameter, 17ft. 3in. pitch.

The steam pressure at the throttle of the turbines will be 250 lb. per square inch, the superheat at the throttle 100 deg., and the vacuum 28$\frac{1}{2}$in. There are to be twelve Babcock and Wilcox oil-burning marine boilers, each having 4600 square feet of heating surface and 1344 square feet of superheating surface.

The electrical equipment will consist of two 6600-kilowatt generators running at a speed of 2888 revolutions per minute and generating current at a pressure of 4000 volts. Two main synchronous induction motors will be directly coupled to the propeller shafts, which will run at a speed of 120 revolutions per minute. There will also be four 500-kilowatt direct-current generating sets and a control board. No attempt has been made to reduce the weight below that of apparatus used for land purposes.

	lb.
The weight of the two turbo-generators, including all accessories, tools, &c., is	306,000
The two main propelling motors	338,000
The complete control equipment, including cables	17,000
	661,000

Weight per shaft horse-power, 39 lb.

In this connection it may be of interest to note that electric propelling machinery has also been laid out for a light cruiser of 120,000 horse-power. In this case weight was of the greatest importance and the equipment will weigh 18 lb. per shaft horse-power. The price of the electrical propelling equipment complete in this case is substantially the same as that of the geared turbine equipment proposed for this ship, but on account of simpler and less costly foundations, piping, oiling system, &c., it was found to be cheaper than any other method of propulsion proposed.

The control apparatus will consist of the necessary contactors for closing the electrical circuits between the generators and the motors, and it will be operated by means of four levers, two for each motor. There will also be two small levers for regulating the speed. One of the two main levers for each of the propelling motors will be for regulating the excitation of the generator and the motor, whilst the other will be a reversing lever with "ahead," "stop," and "astern" positions. The field lever will have four definite positions—"off," "one," "two," and "run." In the number "one" position double excitation will be applied to the generator alone, and with the reverse lever in the ahead or astern position, the propelling motor will be started or reversed as a pure squirrel-cage induction machine. In the number "two" position excitation will be applied to the rotor winding of the motor, whilst double excitation is maintained on the generator, and in this position the motor will pull into step and become a synchronous machine. The run position will reduce the excitation of the generator to normal. Speed variation of the propeller in either direction will be obtained by varying the turbine speed, and will be controlled by the operator by means of a small speed lever on the control board.

Normally both turbo-generators will be in operation. Should, however, it be desired at any time to operate the ship at three-fourths speed or lower for a considerable length of time, only one generating unit need be used, both propelling motors being operated from the control board exactly in the same way as when both units are running. This feature should prove most economical should the ship ever be used for cruises during the slack season, as in this case almost 15 knots can be obtained. The precise method of operating the levers for the purpose of reversing the ship at full speed is described in the paper. The motors and the generators have been designed to give the necessary torque to reverse the propellers from 120 revolutions per minute ahead to 120 astern in 20 seconds. Quicker reversal can be made but is not considered advisable.

When operating with 250 lb. gauge pressure and 100 deg. superheat at the throttle and with 28$\frac{1}{2}$in. of vacuum, the steam consumption per shaft horse-power delivered to the propeller shaft—including all losses in generators, motors, cables, &c.—will be 9·5 lb. when delivering 17,000 horse-power to the propeller shaft at 120 revolutions per minute. When delivering 13,500 horse-power at 110 revolutions per minute under the same steam conditions the consumption will be 9·9 lb. Considerable margin has been included in these figures to cover sea conditions and the inaccuracies of tests.

If electrically-driven auxiliaries are used, the fuel consumption per shaft horse-power hour, including everything, amounts at 17,000 horse-power to ·85 lb., and at 13,500 horse-power 0·90 lb. In these calculations slightly over 1000 kilowatts of direct-current load has been assumed in both cases. Although the ship will be operated with only 100 deg. of superheat, the turbines have been designed to work safely and efficiently with 300 deg. superheat if it should be desired to adopt this degree of superheat at a later date. If the superheat were increased to 200 deg. the saving in fuel would be 5 per cent., and 9 per cent. if it were increased to 300 deg. Electrical propulsion, the author points out, is particularly well adapted to high steam temperatures, as all the reversing is done electrically and no undue heat stresses or temperature changes take place in the turbine itself, as is the case when mechanical gears are employed. The author also points out that in making comparisons of transmission efficiency between a geared turbine drive and electric transmission, it is not right to compare the gear efficiency alone with the efficiency of the electric transmission. Such comparisons, the author contends, are very misleading. In the case of the liner under consideration, for instance, if gears were used the design of the turbine and that of the gears would have suffered in order to compensate for the limitations imposed by the gears. If single gears had been used, as at first suggested, it would have been necessary to build the turbines in three casings in order to secure the proper design, the speed of the turbines proposed being half that possible with the electric drive. Moreover, the number of steam seals and packings was three times as great as that necessary with the electric drive. With electric driving it is possible to design a much more efficient turbine. The increased efficiency arises from the use of a higher speed, the elimination of the reversing turbine losses, the removal of all crossover connections between turbines, the smaller number of packing glands and steam seals, and the closer running clearances.

The actual transmission efficiency, the author points out, is not an index of the comparative economy of the two methods, as the turbine designed for electric driving is always much more efficient than a machine designed for driving through gears, with the same factor of safety and reliability in both cases.

With a load of 17,000 horse-power and a propeller speed of 120 revolutions per minute, the generator has an efficiency of 96·75 per cent., excluding the excitation, which amounts in the case under consideration to 32 kilowatts per generator or less than one-half per cent. Excluding excitation, which amounts to 48 kilowatts per motor, or ·68 per cent., the motors will have an efficiency of 97·5 per cent., whilst the loss in the cables amounts to ·04 per cent. Including excitation the total loss therefore amounts to about 6·75 per cent., whilst for larger powered ships a total loss of less than 6 per cent. may be expected. At reduced speed of the vessel the efficiency of the generator and motors remains practically constant, for the voltage is then reduced in about the proportion of the square root of the horse-power, so that at three-quarters speed the voltage is reduced from 4000 to about 3000 volts, and the transmission loss is only increased from 6·75 to 7·4 per cent., although the load is reduced from 17,000 horse-power to 7000 horse-power. The loss in gear efficiency under similar conditions would be about 2 per cent. The advantages of the electric drive for a large liner are summarised as follows :—

(1) Electric transmission gives a simple and practical means of speed reduction between the high speed turbine and the slow speed propeller with almost any ratio which may be desired. (2) It affords means of reversal by simple change of electrical connections, without changing the direction of rotation of the turbine. (3) Any desired reversing torque up to the full power of the turbine can be obtained without affecting the efficiency of the equipment in the forward direction. (4) Reversal is obtained with a minimum amount of steam drawn from the boilers, as the full inertia of the turbo-generator is first used in the act of reversal. In fact, in most cases actual reversal is obtained without drawing any steam from the boilers, and steam is only used from the boilers to accelerate the propeller speed in the reversed direction. (5) Electrically-driven vessels can be made noiseless, whereas gears always make more or less noise. (6) Electric drive makes it possible to obtain accurate data, either by instantaneous readings or by recording instruments, of the load on the propeller shaft under various conditions of sea and wind, and it eliminates the use of torsion meters; the total horse-power hours being recorded during any time. It is also possible to keep a check between the fuel consumption and horse-power hours developed. (7) Experience on the ships equipped by the General Electric Company of America and the British Thomson-Houston Company has shown that the upkeep of the electrical machinery has been practically nil. (8) The recent tendency is to put some of the large and medium-sized liners on winter cruises or other cruises when the season is slack, and with the electric drive about three-quarters speed can be obtained by putting only one of the two power units into operation, which means a very large saving in fuel and attention; the steam consumption per shaft horse-power being practically the same as at maximum speed. (9) In the design of generators and motors special precautions have been taken, and if for any reason damage occurs to any parts of the windings it can be quickly repaired. In the generators and motors multiple circuits are used, and if a coil is damaged it can simply be cut in two by means of a hack saw and the ends insulated, the loss in power being only in the ratio of this single circuit to the total number of circuits in multiple. If the motor has ten circuits in multiple, and if one circuit is cut out, the power is only reduced by one-tenth. If several coils are damaged, a jumper can be connected across the damaged coils and the vessel can proceed on its journey. (10) In many cases the electric drive offers an important advantage by reason of the fact that the generating unit or units can be placed in any convenient position near the boilers, and the units can be mounted at any desired height, whilst the condensers can be put directly under the turbines, thus reducing the amount of steam and exhaust piping to a minimum. Chances of air leaks, which are so detrimental to good vacuum, are reduced to a minimum. Moreover, the propelling motors can be put near to the propellers, thus eliminating long shafting and bearing losses. Shaft alleys can be eliminated, thus saving hold space and making cargo handling much easier and convenient. (11) The turbine for electrical transmission can be made more efficient than those that are used without electrical transmission, and as no reversing units are required the machine is shorter, resulting in a smaller shaft, less diaphragm packing leakage, and packing and bearing losses. Since there is no heat distortion during reversal, smaller clearances can be used with the same factor of safety; and (12) full advantage can be taken of high-pressure steam and superheat. The remainder of the paper is devoted to the Diesel electric drive.

Back Bay Reclamation, Bombay.

MATTERS not having gone so well as had been anticipated with Bombay's Back Bay Reclamation Scheme, an Advisory Committee was appointed some time ago to investigate and report upon the matter. Our readers may be reminded that the scheme of reclamation affected both east and west sides of the Colaba peninsula, and that it was proposed to reclaim from the sea rather over 130 acres on the east side and nearly 1150 acres on the west side. The reclamation was to be effected by constructing seawalls at the seaward limits of the areas to be reclaimed and filling in the spaces thus enclosed by means of spoil dredged from the sea bottom by means of suction dredgers. The seawalls were to be built partly of mass concrete and partly of rubble mounds formed by depositing rock obtained from a quarry specially opened up for the purpose, concrete blocks being also employed on the seaward sides. The length of the wall on the west side was to be nearly 4 miles. It was originally intended that the spoil should be entirely dredged from the east side of the peninsula, the dredged material destined for filling up the west reclamation being pumped through pipe lines right across the intervening neck of land. That idea was, we believe, eventually given up, at any rate in part, and the dredging for the west reclamation, at all events, was carried out on the west of the peninsula.

A sub-committee, chosen by the Main Committee, asserted in a report made in January last, that whereas, as originally designed, the work was to have taken five

years to complete and to have cost rather over £2,825,000, it would, if carried out in its entirety, actually take some twenty years to finish and would cost nearly 8¼ million sterling. One member of the sub-committee went so far as to express the opinion that the project should be entirely abandoned, notwithstanding the fact that over 3¾ millions sterling have already been expended on it. The majority was, however, in favour of completing certain blocks or portions of the work, one of which the military authorities had agreed to take over, and leaving for a future occasion the decision as to whether the remainder should be undertaken. The Advisory Committee itself reported shortly after the report of the sub-committee had been made public. It handed in two reports, one from a majority of eight, the other from a minority of six. The majority report agreed with the finding of the sub-committee that three blocks or portions—Nos. 1, 2 and 8—should be completed, but recommended that the estimates for the work should be gone through by a committee of engineers. One member of the majority, while he agreed that the three blocks in question should be completed, expressed the view that the whole question should be referred to an entirely fresh committee, which should be instructed to thresh the matter thoroughly out again. The minority report suggested a full inquiry into the question of completing the block which the military authorities proposed to take over.

It may be here explained that of the three blocks which the majority report proposes should be gone on with, Nos. 1 and 2 comprise the area between Marine Line and Church Gate, while No. 8 is roughly the area between the Afghan Memorial Church and Colaba Point.

The whole matter came up for consideration by the Legislature on February 22nd, when Sir Leslie Wilson, the Governor of Bombay, announced that the Government had decided to adopt the majority report of the Advisory Committee and to continue work on blocks 1, 2 and 8. He remarked that it was of paramount importance that they should proceed with great caution and obtain every available expert opinion. They had, he said, already obtained an independent opinion from Sir Alexander Gibb, but that, unfortunately, they were unable to utilise his report without further reference to him. He might say, however, that it confirmed the Government's decision that it was certainly necessary to complete block 8 as soon as possible, and to proceed with blocks 1 and 2 in the most economical manner possible. Going on to discuss alternatives, Sir Leslie said that in the Government's opinion it was wise to continue the reclamation of the three blocks mentioned. It had, he said, been discovered that the figures given in the Advisory Committee's report needed readjustment, and that the prospects were much brighter than those figures appeared to indicate, and the Government confidently anticipated that block 8 would be completed and handed over to the military authorities a year before the time anticipated in the report.

With regard to the other two blocks, Sir Leslie stated that the Government intended to invite open tenders for earth-filling on a large scale in order to compare the economic possibilities of dry-filling with those of filling with dredged material.

Referring to the Government's decision to adopt the majority report of the Advisory Committee, Sir Henry Lawrence, of the Executive Council, in introducing the provincial budget, pointed out that the total abandonment of the work would mean a certain loss of 488 lakhs of rupees—or, at the present rate of exchange, say, £3,660,000—whereas, if the three blocks recommended—Nos. 1, 2 and 8—were completed, the loss would probably be reduced to 300 lakhs, or, say, £2,250,000, with the compensation of securing additional open space for the city. The land, thus reclaimed, should, he explained, be available for sale in 1931, when the market value of the reclaimed areas would show whether it would be wise to continue the rest of the reclamation programme.

Later.

Since the foregoing was set up in type some particulars of Sir Alexander Gibb's report have come to hand. It appears that he recommends the stoppage of the dredging in Back Bay after the close of the present dredging season, and the disposal of the plant. On the completion of Block 8, which is being filled in by pumping from the harbour, the dredging, it is suggested, should similarly be stopped. The report also recommends that Blocks 1 and 2 should be reclaimed by means of moorum* filling, provided that it is obtainable at a reasonable price, and that if it is considered later that all or any of the remaining five blocks can be disposed of advantageously, the reclamation should be completed as required with moorum dry filling.

Sir Alexander also advocates the employment of experienced, efficient and substantial contractors, if it be possible to obtain them, rather than departmental labour, for the completion of the work. He estimates that, excluding interest, the future cost of completing Block 8 will be 27½ lakhs of rupees, of Blocks 1 and 2 45½ lakhs, and of the whole scheme 336 lakhs.

In the telegraphic summary of his report Sir Alexander is further stated to be of opinion that the results of dredging have hitherto been most unsatisfactory and are not likely ever to be economical, owing to the unsuitability of the plant for dealing with existing material. All reasonable care and skill were exercised by those in charge of the work to secure the best results from the dredging plant, and the working costs per annum of the dredging plant were less than the original estimates. The cost of filling with moorum compares favourably with the cost of dredging, and, apart from the dredging, the works comprised in the reclamation scheme were designed efficiently and carried on economically, and in some cases at less cost than the estimates. The standard of the work and the rate of progress, he adds, both compare favourably with similar works in other parts of the world.

SWING SPAN FOR NEW BRIDGE AT WALLASEY

New Swing Bridge for Wallasey.

A new steel swing bridge has recently been constructed by Francis Morton and Co., Ltd., Hamilton Ironworks, Garston, Liverpool, to span the passage between the West Float and Wallasey Pool, Birkenhead, and to replace an old wooden structure known as Halfpenny Bridge. The bridge is completely manufactured, and is now being erected on the site. Our illustration shows the swing span erected in the bridge erecting shop of the makers, prior to being dismantled and shipped by lighter from the company's private dock to Seacombe.

The bridge is 201ft. 6in. long overall by 33ft. wide, and the main girders are 22ft. deep at the centre, the depth decreasing gradually towards the nose and tail ends. It carries a 20ft. clear roadway in the middle, in which provision is made for laying a single tramway track. There are also two 4ft. wide footpaths, which are carried on outrigging cantilever supports along the outer sides of each main girder. The main girders are of open lattice construction built up of steel plates and rolled sections riveted together. The flooring is of pressed steel trough section plates supported upon cross girders underslung from the main girder booms. The roadway is filled in with cork asphalt composition, upon which is laid the roadway proper of creosoted redwood blocks. The footpaths are of greenheart timber laid with open joints.

The bridge proper is supported upon a large turntable carried on a centre pivot, and there is a nest of rollers to provide an easy turning movement, the bridge being turned by hydraulic rams operating steel wire ropes connected to a rope slewing drum on the turntable. In order to balance the bridge when swinging, 200 tons of cast iron kentledge are arranged in the tail end, to counterbalance the heavier weight of the long arm over the passageway. The bridge complete weighs about 700 tons.

The new shaft at the Michael Colliery of the Wemyss Coal Company, on the shore of the Firth of Forth, is to be sunk by means of the François cementation process. The same system is to be adopted for the Mersey Tunnel.

* Moorum is a kind of gravel much used in road-making.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

CUTTING TEMPERATURES.

Sir,—In replying to your remarks on my paper I should like to join you in regretting the absence of criticism from the discussion at the London meeting. I was thereby deprived of the opportunity of dealing with the various points of difficulty raised in your editorial, and with several others. I hoped and fully anticipated that these points would arise in the course of discussion.

Having been allotted "ten or fifteen minutes" for the presentation of the paper, I was unable to deal as fully as I could have wished with several matters to which you have directed your readers' attention. Perhaps you will allow me to deal with them now.

The piecemeal presentation of the subject was to be regretted, but was unavoidable. There were special reasons, to which you refer, for avoiding delay in publishing results of a research which was, and still is, in an early stage, and most of the results placed before the meeting had not been arrived at when the paper was printed.

The paper as published may be said to have dealt exclusively with tool temperatures. The surfacing method of investigating the effect of temperature on the work material was indeed mentioned, for the purpose of placing it on record, but no work temperatures were given and no inferences drawn. When, therefore, you say "the temperatures which Mr. Herbert measures . . . are definitely not those which, from the original paper, we might very readily be led to believe them to be," and further on "Regarded as tool temperatures and not as work temperatures, Mr. Herbert's measurements are less conclusive and somewhat less enlightening than we at first thought them to be," I search and, I must confess, search in vain for the grounds on which your strictures are based.

The tool-work thermo-couple measures the temperature between the tool and the portion of the work material with which the tool is in contact. This temperature, assuming that it is correctly measured, is the temperature which the tool steel has to withstand. If the tool steel is softened by this temperature the tool will quickly fail. If the steel retains its hardness at this temperature the tool will continue to cut.

The productivity of every metal working establishment is limited by its cutting temperatures and by the heat-resisting properties of its tools. These are the temperatures I have measured, and although you fail to find them enlightening you omit to state the reason why.

The question whether they are correctly measured remains to be discussed, and, as you rightly point out, this depends on the soundness of the method of calibration.

At a certain stage of my investigations I was approached by an eminent metallurgist, who, in the most helpful spirit, gave me reason to believe that the thermo-electric properties of strained and unstrained metals might be very different. My original intention had been to calibrate couples composed of the tool and the chip; but chips are fragile, and for this sole reason the original intention was abandoned, and the calibration was made between the tool and a strip of unstrained metal planed from the bar. It appeared therefore that in measuring the voltage generated in cutting between the tool and the highly strained metal of the chip and in calibrating a couple composed of the tool and unstrained metal I might have reached erroneous results.

This matter was taken very seriously, partly because it might be necessary to revise the scale of temperatures and partly because the suggested difference of thermo-electric properties between strained and unstrained metal promised to yield a very useful method for detecting and exploring local strain hardening. The matter was put to the test in the following manner.

A heavy cut, ⅛in. deep by ¼in. feed, was taken on a steel bar. The lathe was stopped with the chip undetached, and a section was cut through the chip and a portion of the bar. This section (not the one exhibited in London, but a much heavier one) was tested for hardness with the pendulum hardness tester in some fifty places, and a map was drawn carefully to scale, showing the hardness at every point—a complete chart of the location and degree of strain hardening, from the undistorted metal of the bar to the highly strained metal of the chip. The section was insulated and placed in the electric furnace. A stylus was made of unstrained steel cut from the same bar, and a sensitive galvanometer was connected between the stylus and the chip. As the temperature was raised every part of the section was explored by touching it with the stylus.

The expectation was that when the unstrained stylus touched an unstrained area of the section no voltage would be generated, but that when the stylus touched strained metal the resulting voltage would serve not only to detect, but even to measure the degree of strain hardening.

The result of this experiment was negative. Not the faintest indication could be detected of a thermo-electric voltage at any point. I was forced to conclude that my projected method of investigating strain hardening was useless, and that my method of calibration was not "unsound."

The subject of tool temperatures was dealt with exclusively in the paper; that of work temperatures exclusively in the supplementary matter placed before the meeting, inadequately owing to the vastness of the subject and the limitation of time. The question confronting me was of this nature. If the temperature between the tool and the chip is, say, 400 deg., what is the work temperature? The answer might have been anticipated, but it has, so far as I know, never before been given, and it only dawned on me after rather extensive experimenting. There is no work temperature. There is a continuous rise of temperature from the minimum in the cold undistorted metal of the bar, through the slightly distorted and slightly heated metal in advance of the tool, through the highly distorted and more intensely heated metal at the root of the chip, to the maximum at the frictional surface between the chip and the tool.

You say "the practically important factor to be determined is the temperature generated in the work and affecting its machinability. Mr. Herbert's methods . . . leave that temperature as indeterminate as ever it was." So be it. If a temperature gradient can be correctly described as an indeterminate temperature, then the work temperature is indeterminate and will always remain so. But I am not convinced of the adequacy of the description.

It is certain that when the tool is cutting under conditions that produce the Whitaker ring the temperature gradient rises from the cold bar, through the free cutting or low work-hardening

range about 120 deg., and up to the much higher temperature (about 380 deg.) between the tool and the chip. The precise stage in the formation of the chip which then coincides with the critical temperature of 120 deg. is not known, but it is certain that some portion of the metal which is in process of being cut is at that temperature, and that when this occurs the resistance to cutting and the evolution of heat are at a minimum and the ring is produced.

In conclusion, will you allow me to thank you in anticipation for the courtesy of publishing my reply to your helpful criticism, and to express a doubt whether you will ever find an individual more fully convinced of "the difficulties in the way of measuring cutting temperatures" than EDWARD G. HERBERT.

P.S.—Will you allow me to correct an error in your very fair report of the meeting? The statement that "The ring can be produced in all crystalline metals from tin to tool steel" may prove to be correct, but goes beyond the experimental evidence at present available. The D2 depression in the work-hardening curve has been found in all such metals, and the ring, which is believed to be a concomitant of that depression, may be expected to occur, but it is a recent development and has not been fully investigated.

[We feel certain that had the information which Mr. Herbert has now given us been made available at the time when he presented his paper many of those in his audience would have been in a better position than they were to appreciate the true significance of his experiments. We still cannot discover in the original paper any definite statement that the temperatures measured were those generated between the tool and the chip. On the contrary, we find numerous suggestions that the method employed is capable of measuring the temperature attained by the work. It is stated, for instance, at one point that the thermo-couple system is constituted by "the cutting edge of the tool and the portion of metal which it is cutting," and at another it is definitely claimed that the method of investigation employed provides a means of "showing the temperatures to which the tool and work are subjected at every stage." Since Mr. Herbert has now expressed agreement with our view that his methods do not enable him to measure the temperature generated in the work it is unnecessary to quote further from the paper statements which can reasonably be held as implying that the measurement of such temperatures was one of Mr. Herbert's main objects. As regards the problem of calibration, we are not prepared to accept the negative result of the unstrained-strained-metal couple as in any way conclusive of the soundness of Mr. Herbert's methods. For the moment, however, we prefer to leave this interesting aspect of the matter open for discussion.—ED. THE E.]

CULTURE FOR ENGINEERS.

SIR,—Mr. C. L. Bryant's letter in your issue of February 19th, and your comments thereon and the leading article to which he refers, have drawn attention to a matter of great importance to all who desire to be something more than mere repositories of technical knowledge and skill.

That apostle of culture, Matthew Arnold, told us that "culture is a criticism of life." This was amplified by Professor Huxley with the statement that "culture implies the possession of an ideal, and the habit of critically estimating the value of things by comparison with that ideal." I quote Huxley as one who was not only a man of great scientific attainment, but also one who had to a remarkable degree a gift of clear expression in his native tongue. In addition, he possessed a knowledge of Latin and Greek which commanded the respect of classical scholars.

What, then, is an ideal? I venture to suggest as a working definition that it is at once an outline of things as we think they might be, and a hope that that outline will some day be bodied forth in reality. And to have an ideal implies the possession of creative imagination. Now, while an ideal may, in its relation to things, be aesthetic or utilitarian or social ("things" including human beings) or what not, it *must* be shaped by the application of moral principles. For none of us can live as members of an organised polity without reacting on our fellows. Our ideals inevitably play their part in that reaction; and moral principles consist of those rules of conduct which, guiding us in our relations with our fellow-men, contribute to the welfare of society as a whole and enable the individuals who compose it to reach the fullest and highest life attainable by man.

If these statements are true, we must ask ourselves: Can creative imagination be stimulated? If so, how? And are moral principles given a sufficiently prominent place in our system of education, "classical" or otherwise?

Imagination, I suggest, is stimulated by *experience which involves contact with realities*. As Francis Bacon long ago pointed out, we must study things and not merely words about things. For "words are but the images of matter" and "lead mankind into vain and innumerable controversies and fallacies" producing "cobwebs of learning, admirable indeed for the fineness of the thread but of no substance or profit." Experience at second hand, such as that obtained by reading, only has value as an imaginative stimulant when it is linked to experience obtained at first hand. That is why knowledge based on reading alone is often found to be ineffectual; and in a similar manner experience based on travel, when it involves seeing things without that close contact which leads to seeing into the real nature of things, will never stimulate the imagination to any appreciable extent. Hence we sometimes find an illiterate, untravelled peasant with a deeper knowledge of realities (such as life and death, growth, weather and the soil) and a more highly developed imagination than a book-reading traveller who may have been many times round the world. Or to take an illustration from our own profession, I have met skilled mechanics with imaginations more highly developed than, let us say, some professors who have spent a lifetime "chasing x" through one text-book after another.

The study of reality is the basic principle of science. To quote Huxley once more: "The student to whose wants the mediæval university was adjusted, looked to the past and sought book-learning, while the modern looks to the future and seeks the knowledge of things." And because of this I claim that where true culture is concerned a liberal education would place science before literature and "the classics," in order of importance.

There is a further aspect of this matter. In so far as knowledge of realities has to be expressed in language, it is surely desirable that that language should be the one which, so to speak, fits the mind like a glove; the language which we associate with the affairs of every-day life; our own living and still evolving tongue. For that is the medium in which we find surest and clearest expression; containing, as it does, the words which are almost inseparable from our earliest thoughts and feelings. And since our range of clear expression in this medium depends upon the extent of our control of it, time available for language study should be given to our own tongue rather than to others. Further, since it is the value of things as they are that we wish to measure against our ideals, living languages should be given preference over those of bygone civilisations which were faced with problems often only remotely resembling those of our own time.

Coming finally to moral principles, I contend that here we find education and culture to be startlingly inadequate to the needs of modern life. I have particularly in mind our social ideals. For example, the problem of how to achieve a high level of civilisation is solved so far as material considerations are concerned. Our technical education is amazingly efficient, as the mastery of the scientist and the engineer over physical laws bear abundant witness. There is no longer a *material* problem of production. Machinery and facilities for production exist far in excess of effective demand. Also we know how to cope effectively with a great number of social evils. And yet, in many cases nothing is done; and even when some effort is made to improve matters it is often at the instance of a small minority struggling against the apathy and even opposition of the bulk of the people. Thus, for example, we are treated to a spectacle in which "a part of the goods which are annually produced is, strictly speaking, waste; because it consists of articles which either should not have been produced until other articles had already been produced in sufficient abundance, or should not have been produced at all. And some part of the population is employed in making goods which no man can make with happiness, or indeed without loss of self-respect, because he knows that they had much better not be made, and that his life is wasted in making them." If moral principles were kept to the forefront of our educational system it would be more generally realised that no individual can justify the maintenance of conditions and activities which are prejudicial to the welfare of the people as a whole.

These, then, are of cardinal importance in the pursuit of culture—the study of realities and the inculcation of moral principles. Indeed, he who is concerned with the former, and therefore with truth, is already well on the road to the latter. For truth is the bedrock of morality.

I submit, in conclusion, that until moral principles are given precedence over all other matters where education is concerned, any attempt to achieve culture must result in a sham refinement, serving only to veneer a comfortable evasion of disharmonies which threaten to destroy the whole fabric of society. Though men take all literature for their province and make all the forces of Nature subservient to their will, of what avail are their "culture" and technical mastery if they are unable to solve the basic problem of harmonious social development?

Cardiff, March 1st. HUGH P. VOWLES.

WHIRLING SPEEDS OF DRUM ROTORS.

SIR,—Mr. Fearn is quite correct when he states that the expression $\frac{30}{\pi}\sqrt{\frac{\Sigma w y}{\Sigma w y^2}}$. y does not exactly give the whirling speed of a shaft. I do not remember that Mr. Wallace or any of the text-books that give this method claim that it gives exact results. However, the results obtained are very near the whirling speeds—see the results obtained by Mr. Wallace, THE ENGINEER, 1916—and even for loaded tapered shafts—see "Whirling Speeds of Loaded Tapered Shafts," Inst. Civil Engineers, Selected Engineering Paper No. 24—I showed that the expression quoted above gives very close results.

The University, Leeds, February 25th. T. M. NAYLOR.

THE TRAINING OF ENGINEERS.

SIR,—In your footnote to the letter of Mr. C. L. Bryant you refer to your pleasure in noting that your correspondent referred to the "Lives" of certain eminent men. I wonder how many engineers in this old country realise the wealth of sound practical common sense which your expressed pleasure contains?

My experience prompts me to give this point emphasis. I was trained in the Colonies, and although moderately well equipped as regards the fundamental laws, there was hardly a day passed but some new problem had to be solved. There was no appeal to authority or specialists; the job had to be done somehow, with the result that the training and experience gained was one which I used to think of at that time as unscientific.

Having lived in this country for nearly twenty years, I have learned something of British engineers' experience and outlook, and although I have the very highest regard and admiration for my home colleague, I have been deeply impressed with his lack of desire or initiation to tackle a job outside his particular line of experience.

Is not your suggestion going to carry us a long way towards supplying this missing link? Something of the "Lives" of eminent men could be worked into the syllabus at suitable points, perhaps as introductory matter; but the practical point is that it could be worked in without taking up a great deal of time. It could be condensed; the main point, it seems to me, is to show the young engineer that our great forbears did not go straight to their objectives, but had to struggle in many side eddies and take many devious tracks before they even saw daylight on their immediate goal. If those personal travels of our great engineers and others were brought to the notice of the rising generation—even quite briefly—it would awaken a line of thought which would have a value beyond estimation; such latent power being very clearly demonstrated during the late war period.

London, February 27th. JOHN D. TROUP.

SIR,—With reference to the correspondence in your columns regarding the education of the engineer, Mr. Bryant says in his letter that he cannot understand why there should be more value (if there is any) in the study of one of Julius Cæsar's achievements than in the study of a modern achievement, such as the making of the Panama Canal.

I would suggest that the study of ancient history of achievement possesses more value than the study of modern achievement as regards broadening the mind and sympathies, for the following reasons:—

(1) The mere distance of time, the contemplation of vastness always having an elevating influence on the mind, and a mind that can travel up and down the centuries of time with ease is always more liberal and more cultured than a mind that has dealt with contemporary events only.

(2) The admiration and wonder excited by the knowledge that humanity should be so noble so early in its history help to exalt the mind of the student.

(3) It is acknowledged that early mankind had a marvellous courage, for they ventured into the unknown to a far greater extent than is possible to-day, with our proved knowledge and almost certain surmises. Making the Panama Canal, mighty achievement though it is, was helped to some extent by experience based on the previous attempt.

(4) It is also acknowledged that the study of other times and other nations makes international understanding easier, thus encouraging the cause of peace.

I think I have made a case in favour of the history of ancient achievement as far as cultural value is concerned. Of course, it is agreed that the study of modern achievement is absolutely necessary as regards the technical side of the engineer's education; this goes without saying. E. E. SIMPSON.

Chelsea, S.W. 3, February 26th.

DIESEL ENGINE USERS ASSOCIATION.

At the February meeting of the Diesel Engine Users Association, which was held on 19th inst., Mr. E. W. Johnston, the newly elected president, occupied the chair. In his opening remarks the chairman stated that this was the fourteenth year of the Association's existence, and that during the past years an increase in membership had taken place. Mr. Geoffrey Porter, Assoc. M. Inst. C.E., then read a paper on "Heavy Oil Engine Installations: Choice of Site and Lay-out of Plant." This paper follows an earlier paper by the same author on "Some Considerations Effecting the Choice of a Heavy Oil Engine," which was read on December 16th, 1923.

The author said that, in general, the choice of a site for heavy oil engine plant was less difficult than that of a site upon which reciprocating or other steam machinery was to be erected. The storage of oil, for instance, presented little difficulty. It occupied comparatively small space and in its handling was entirely free from the dust and dirt inseparable from the storing of coal in large or small quantities.

Among other things, the selection of a site depended much upon the relative importance attached to the character of the subsoil, the proximity to a natural supply of clean water, and freedom from flooding, the proximity and the type of neighbouring property and transport facilities. Considerable importance had to be attached to the avoidance of vibration, and in this connection the most favourable type of subsoil was one that was dry and consisted of closely compacted particles capable of small relative movement. In deciding upon the number and individual capacity of generating sets for a given total capacity, the primary consideration to be borne in mind was the running plant load factor; in other words, the range of capacity should be such that no engine would be required under normal circumstances to operate at light loads, a light load being estimated as one below 50 per cent. of the maximum continuous rating of the engine. In the course of his paper, Mr. Porter dealt in considerable detail with such questions as the avoidance of trouble from vibration, the determination of the character of the cooling water supply and necessary treatment, the storage and handling of fuel oil and the arrangement of cooling water systems.

In conclusion, the author remarked that a good plant should be well housed, well cared for, and kept scrupulously clean. Good results could only be gained by maintaining the interest of the running staff. If indifference on the part of the management was a characteristic of the undertaking, then the staff would very soon lose its interest, and the owners would not receive the return to which they were entitled.

An interesting discussion followed the reading of the paper.

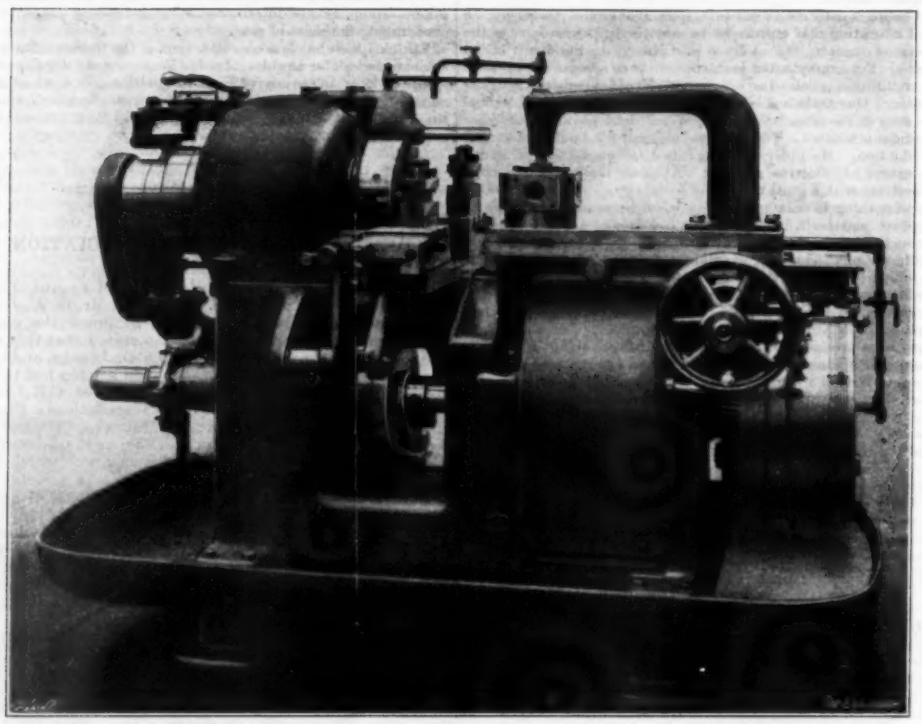
UNIVERSAL BALL JOINT.—We have received from B.E.N. Patents, Ltd., of 100, Victoria-street, Westminster, a sample of a very handy form of ball joint for such purposes as connecting control rods with cranks and levers. In the place of the usual screwed retainer, for holding the ball in the socket, there is a simple split spring ring, housed in a recess in the socket. The ball can be pushed past this ring into place or pulled out again with a good strong pull. Dismantling is consequently greatly simplified, while there are no loose parts to mislay. The joint has an angular range of 60 deg., but can, of course, only be used for transmitting thrust in one direction.

ENGINEERING GOLFING SOCIETY.—The seventeenth annual general meeting of the Engineering Golfing Society was held, by permission of the Council of the Institution of Civil Engineers, in the Institution building, on Thursday, February 25th, the retiring captain, Mr. J. R. Sharman, in the chair. The office bearers for the current year were elected as follows:—President, Sir Alexander Kennedy; Vice-presidents, D. A. Stevenson, E. L. Mansergh, F. J. Walker, S. Price-Williams, G. Midgley Taylor, W. H. Shortt, E. W. Timmis, K. A. Wolfe-Barry and W. L. Mansergh; Captain, D. T. Powell; honorary secretary, G. M. C. Taylor; honorary treasurer, H. P. Allison; honorary auditor, S. C. Lewis; elected members of Committee, F. Bolton, W. A. Brown, C. S. Davidson, R. E. Doowra, H. G. Hale, R. J. M. Inglis, S. R. Lowcock, H. E. Midgley, and F. R. Phipps.

UNIVERSITY COLLEGE ENGINEERING SOCIETY.—The annual dinner of the University College Engineering Society was held in the College Refectory on February 26th, with Sir Ernest Moir in the chair. If not quite so well attended as in some recent years, there was still a numerous company of members and guests. After dinner Sir Ernest Moir gave a short lantern lecture on the construction of the new engineering wing, and in it laid particular stress on the value of "costs" to young engineers. To exemplify his remarks on that point, he gave many figures for the work in question, a number of them being based on men-square yards or cubic yards, as the case might be. He drew the students' attention to the convenience of costs taken out on that basis, for it gave a direct means of comparison with known contracts which was not affected by the rates of pay and so on. The toast of the Engineering Society was proposed by Professor E. A. Gardner, and was acknowledged by Mr. R. E. W. Butt, the chairman of the Society. Professor Coker proposed the visitors, and Mr. W. H. Patchell and Dr. James Mould replied. Subsequently Professor Coker announced that a Fellowship of the University had been conferred upon Mr. L. A. Legros, a former student and a son of the one-time director of the Slade School. In acknowledging the dignity Mr. Legros gave some amusing reminiscences of his life as a young man at University College.

AUTOMATIC LATHE

ALFRED HERBERT LTD., COVENTRY, ENGINEERS



An Improved Automatic Lathe.

The machine illustrated in the accompanying engraving is about to be placed on the market by Alfred Herbert, Ltd., of Coventry, as an improved design of the firm's well-known No. 2 automatic lathe. All the operations of the machine are automatic except those involved in chucking the work, and the lathe can be arranged to stop automatically either at the end of the work or, if required, at the end of a cut.

An important improvement consists of the total enclosure of the headstock, so as to form an oil bath for the gears and bearings. The headstock is equipped with an automatic two-speed change mechanism, which is brought into action by dogs on a change-speed disc at the left-hand end of the machine. From the same disc the starting and stopping of the spindle is also controlled. The spindle is driven from the driving shaft through spur gearing, and is carried in white metal bearings with a large ball bearing to take the thrust. In order to reduce the wear at high speeds to a negligible amount, the driving shaft, together with its loose pulleys, is mounted in ball bearings in place of the plain bearings formerly used. For general work a double countershaft is supplied, whereby sixteen spindle speeds, ranging from 20 to 170 revolutions per minute, are obtainable. For repetition work a single countershaft is provided, giving two spindle speeds, which are arranged to suit the particular work for which the lathe is required. The spindle is flanged at the front end for the direct attachment of the chuck, and is hollow to accommodate the drawback arbor and to permit a back facing attachment to be used. The back-facing attachment is intended for machining inside the bosses of work held in the chuck, and is claimed frequently to enable a piece to be completely machined at one setting instead of two. A support consisting of a stiff bar projects from the front of the headstock. By means of a pilot bush on the tool and sliding on this support, knee tools and combination boring, turning and facing tools can be steadied in such a way that the coarsest feeds, it is claimed, can be used without overstressing the turret. This arrangement is said to be of particular value if a piloted boring bar cannot be used, or if the pilot is of small diameter.

The capstan slide can be adjusted by rack and pinion away from or towards the chuck through a range of 9½in., in order to accommodate work of varying lengths. The cam drum moves with the slide during this adjustment. Rigid support for the capstan post is provided by an overhead arm attached to the slide. The capstan has four faces, each with a 1½in. tool hole, which is fitted with a clamping pad. The cam drum operating the slide is totally enclosed, and runs in an oil bath. The cams and the bolts securing them to the drum are made of chrome-nickel steel. A maximum working stroke of 6½in. can be given to the capstan.

An improvement has been effected in connection with the front and back cross slides, which are now mounted independently on a common lower slide. The two slides, if required, can still be used simultaneously. Each cross slide has a fine screw adjustment and a dead stop to regulate the depth of the cut, and is equipped with a double open-sided tool post. The maximum stroke of each cross slide is 3½in., and is given by a cam mounted on an adjustable disc which can be readily set and locked, so as to come into action at any desired point in the cycle.

Another improvement effected consists of the substitution of a belt drive for the feed motion in place of a gear drive from the spindle. The feed motion is driven from the headstock and interchangeable pulleys are provided which give two ranges of feed. On each range a self-selecting feed motion gives seven feeds for each cam associated with the turret or cross-slide movement. The changes effected by the self-selecting feed motion are automatically controlled, as each tool comes into action, by a drum at the right-hand end of the machine. Corresponding to the seven feeds this drum has seven circles of holes, and into any of the holes a change feed pin can be placed. As the cam shaft rotates, these pins automatically set the rate of feed before the tool begins to cut in each operation.

The idle motions of the turret and slides are driven from the countershaft by an open belt at a constant speed. Changes from feeding to idle motion are made automatically by a series of dogs clamped in a dovetailed groove in the control drum at the right-hand end of the machine. A second series of dogs in a parallel groove controls the change from idle motion to feeding.

A hand feed wheel is provided whereby the cam shaft can be turned when the machine is being set up. This wheel does not rotate when the machine is working automatically. A disc in front of this wheel when pushed in or pulled out starts or stops the automatic feeds.

The machine can swing a maximum diameter of 8¼in., and in its drive absorbs about 6 horse-power.

South African Engineering Notes.

Platinum Production in the Transvaal.

An event which is not only of historic interest, but of very considerable economic importance, has just occurred, the Onverwacht platinum mine, of the Transvaal Consolidated Land and Exploration Company, having extracted a quantity of platinum from the ore which its plant has been crushing since the middle of January last.

Since the finding of platinum in various parts of the Transvaal late in 1922—although the discovery was not generally known until early in 1923—some forty companies, with nominal capitals totalling together over five millions, have been formed to work areas which they have bought, leased, or have options upon. The outstanding mine of all is undoubtedly that belonging to the Transvaal Consolidated Land and Exploration Company upon its farm Onverwacht. There, a kopje of solid dunite formation gave a first sample on the outcrop of 33 dwt. of platinum per ton. The surface of this remarkable occurrence measured 60ft. by 60ft. A vertical shaft was sunk which, up to the present, has reached a depth of 250ft., at which depth the pipe area has decreased to 50ft. by 50ft. approximately. Average values down to 50ft. were 17 dwt.; from 60ft. to 70ft. the average was 58.4 dwt.; from 70ft. to 80ft. it was 41.2 dwt.; from 80ft. to 90ft., 41.3 dwt.; and from 90ft. to 100ft., 14.6 dwt. Cross cuts at that level showed as high and higher values. Values then diminished at lower depth, and at 150ft. the average was 6.7 dwt., while at 200ft. it was 4 dwt. From 200ft. to 242ft. values were erratic: 1.8 dwt. for 200ft. to 210ft., and 2 dwt. for 210ft. to 220ft. From 220ft. to 230ft. the average rose to 9.1 dwt., while from 230ft. to 240ft. the average values were 80.8 dwt., and from 240ft. to 250ft. no less than 198.7 dwt. Cross cuts at that depth gave, for distances of 20ft. and in different directions, an average of 97.4 dwt. The extraordinary richness of this ore has not been approached by any of the other enterprises in the district.

The development of the mine and the equipping it with crushing and concentration plant has been pushed with the utmost possible speed, and the mine is now the first actually to produce platinum on a commercial scale.

The full particulars of the process of treatment adopted are not yet available, but it is known that the ordinary crushing and concentration processes are followed by an electro-chemical amalgamation process, which, it is understood, is not to be patented, but of which details have not up to the present been disclosed. In the final stages porcelain dishes containing the concentrates are heated over oil stoves. One dish examined was found to contain 117 oz. of platinoid sponge, containing 70–75 per cent. of metallic platinum, said to represent a value of from £1500 to £2000. The total quantity produced to date has not yet been declared, but it is known to be of a substantial nature.

Since the Onverwacht plant commenced milling, in the middle of January, a maximum of 30 tons per day has been put through the mill. It is hoped that, in the near future, when additional power is available and finishing touches have been given to the initial installation, a considerable increase in tonnage will be secured. The present position as to the underground working is that the management has in contemplation the resumption of sinking at the 250ft. level, the immediate depth aimed at being 300ft. A new vertical three-compartment shaft, which will be equipped with hoist and head frame, is being sunk. It has a concrete collar and has reached a depth of 50ft. This shaft is situated outside the zone of the "pay" rock, and it will penetrate the "Nortonolite dunite" ore body by means of a cross cut.

CONTRACTS.

Vickers Ltd. have secured an additional order for a third unit for the Holborough Cement Works, Snodland, Kent, which comprises a kiln, cooler, wash mill and mixer plant.

Mr. R. H. Longbotham asks us to announce that he has entered into an agreement to take over the assets and to discharge the liabilities of R. H. Longbotham and Co., Ltd., and that that company is therefore being liquidated. The business will now be carried on by him personally at Northwood, Middlesex.

The Ransome Machinery Company (1920), Ltd., of Windsor House, 46, Victoria-street, London, S.W. 1, has recently received an order from S. Pearson and Son, 10, Victoria-street, S.W. 1, for two No. 0 size and four No. 1 size Ransome concrete mixers, fitted with electric drive; also for ten Ransome type A tip carts, for use on the contract Cia Hidro-Electrica Volcan, Santiago, Chile, South America.

Mr. P. Pitman, 25, Victoria-street, Westminster, London, S.W. 1, has secured an order for a hydro-electric plant for the Banbridge Gas and Electricity Company, Ltd., Ireland; and others for an impulse turbine and electric generator for Marconi's Wireless Telegraph Company, Ltd.; a Francis turbine and generator for General Hildebrand, of Higham, Colchester; and a Pelton hydraulic motor for the South Metropolitan Gas Company, Ltd.

International Combustion, Ltd., informs us that it has found it necessary to proceed immediately with a considerable extension of its works at Derby. A new foundry section for heavy castings, with core drying ovens, pattern shops and storage, cupolas and complete range of modern handling equipment is to be started at once. The extensions also include for an entirely new machine shop, &c., office extensions, and a new shop for the fabricating of sheet metal work. Provision has also been made for extending the transport system, loading and despatch berths to the new buildings. At the Barrow Works additional machinery is to be installed immediately for dealing with the manufacture of Raymond pulverisers.

The Westinghouse Brake and Saxby Signal Company, Ltd., has received from the Metropolitan Railway an order for the supply and installation of material required for the re-arrangement of the power signalling between Edgware-road and Praed-street, Baker-street and Bishop's-road stations, necessitated by the enlargement of Edgware-road Station. The apparatus will be of the alternating-current type. The same firm has received an order from the Ministry of Transport to provide eight three-aspect colour light traffic signals for the regulation of traffic along Piccadilly from east and west, and entering Piccadilly from the north by Berkeley-street, Dover-street, Albemarle-street and Old Bond-street, and from the south by Arlington-street and St. James's-street.

The Great Western Railway Co. officially announces that the following contracts have been placed:—(*a*) Overhaul of dredger Duchess and tug Swansea, the Penarth Pontoon Slipway and Ship-repairing Company, Ltd., Penarth Dock; (*b*) construction of fifty covered fish vans, Metropolitan Carriage, Wagon and Finance Company, Ltd., Saltney, Birmingham; (*c*) construction of 100 12-ton covered goods vans, the Gloucester Railway Carriage and Wagon Company, Ltd., Gloucester; (*d*) construction of new booking hall and buildings at Newton Abbot, Messrs. A. N. Coles and Son, St. Anne's Battery, Plymouth; (*e*) extension of Thomas-street subway and other works at Newport, Messrs. E. C. Jordan and Sons, Harrow-road, Newport, Mon.; (*f*) renovation and rearrangement of premises at Westbourne Park, William Brown and Sons (Builders), Ltd., 195, Uxbridge-road, London, W.; and (*g*) supply of two 14ft. wagon turntables for Smithfield depôt, the Patent Shaft and Axletree Company, Ltd., Wednesbury.

The Institute of Metals.—The Institute of Metals has just issued to its members a ballot paper containing the names of seventy-seven candidates for membership—a record list. This is the last occasion upon which a postal ballot for the election of members will be taken. In future election to membership will be by the Council, assuming that the new articles that have recently been drawn up by the Council are approved by the members at the extraordinary general meeting of the Institute to be held on March 11th. These articles were drawn up, we understand, primarily to do away with the postal ballot system, in which there was returned only about 10 per cent. of the voting papers issued. Members will still have an opportunity of objecting to any membership application, as one of the new articles provides that "the names of the approved applicants shall be placed on a list which shall be exhibited in the library of the Institute for at least fifteen days immediately after the Council meeting at which such names were approved." Copies of the lists are to be supplied to the secretaries of local sections of the Institute for inspection by members, and in any other manner to members as may from time to time be prescribed by the Council. Power is sought by the Council to vary the constitution of the Council. The most important change is that which provides that the chairman of any local section may be co-opted a member of the Council. The six past-presidents who shall be *ex officio* members of the Council will be limited to the six most recently retired from the office of president. The election of the Council will continue to be by postal ballot of the members of the Institute. The first election of members under the new arrangement is proposed to be held on April 21st. Applications for membership should be sent to the Secretary, Mr. G. Shaw Scott, M.Sc., 36, Victoria-street, S.W. 1.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Conditions.

NOTHING has occurred during the past week to animate the Midland iron and steel market. The quiet conditions noted of late continue to rule, but this is not an unusual feature of the market at this season. The demand alike for iron and steel materials is principally confined to small orders for near delivery. The prevalent anxiety as to the coal situation discourages confidence in contracting, and buyers and sellers avoid commitments beyond April. Industrialists generally refuse to believe to-day, as they refused to believe last summer, in the imminence of rupture in the coalfields, and it does not appear that stocks are being accumulated by way of precaution. The threatened "lock-out" in the engineering industry is causing Midland industrialists concern. There are approximately 400 engineering firms in Birmingham and district employing 40,000 operatives. Strikes and lock-outs are alike the enemies of industrial progress, and to answer a strike of 900 men with a lock-out of 600,000 would not be a very hopeful method of securing peace. Moreover, this dispute has clearly already had a very bad effect on the national wage negotiations, and the men would be wise to get it out of the way, leaving the field clear for the bigger question. Hopes are entertained that reason will prevail, and that not only the sectional dispute, but also the national trouble will be settled without recourse to the double-edged "strike" weapon. It is recognised by industrialists hereabouts that the root of the trouble is the deep depression in trade, but there are signs that even the engineering trades are now on the upward grade, and this therefore, they urge, is the time not for conflict but for co-operation.

Steel Business.

The demand for steel is almost entirely constructional and largely connected with building activities. Midland constructional engineers are kept busy tendering for a wide variety of important buildings. Formerly, the engineers were mainly concerned with the construction of bridges, but such structures now form an almost insignificant portion of the work given out. Railways are still constantly issuing specifications for station reconstruction. Builders of rolling stock in this district are well occupied, and there is every hope that the Birmingham shops will share in a pending contract for 1000 wagons for the Egyptian Railways. Good quantities of iron and steel are being taken from the Staffordshire works for this class of construction. The firmer tone which characterised steel prices a few weeks ago was only transient. Steelmasters, in their endeavours to get sufficient orders to keep plants running, are accommodating prices to consumers' ideas in many directions. Sections can be bought at £7, though quotations are generally 2s. 6d. to 5s. above that figure. Northern mills are willing to deliver bridge plates in this district at £7 15s. rather than lose an order. Business has been done in small bars at £7 17s. 6d. to £8, but this is not the irreducible minimum. The plate trade, in ship and boiler material, remains rather sluggish. Billets are offered at £6 to £6 2s. 6d. Very low prices are quoted by the Continent, and owing to increased production and keener German competition, further reductions in foreign prices are considered likely. Belgian semi-finished steel, however, is not plentiful, and is now much less competitive at the price quoted, namely, £5 10s. delivered. It is reported that continental billets have this week changed hands at 1s. per ton below this figure. Belgian bars are offered at £6 10s. to £6 12s. 6d. Wire rods rolled from continental billets have been put up to £9. For all-British rods £9 10s. is required.

Scrap.

Steel scrap is selling slightly more freely, on the basis of £3 10s., although easier prices are quoted for an attractive line. South Wales is a better customer. Importations of foreign steel have increased somewhat, introducing an element of price uncertainty.

Raw Iron Values.

In spite of the strenuous efforts made by Mid land producers of pig iron to keep up selling values, price are a shade weaker this week. Blast-furnacemen were in no mood lightly to accept lower prices. Coke requirements are in many cases uncovered, and furnacemen intimated that they preferred to curtail output rather than maintain production at the sacrifice of the present price level. There has, however, been a slight easing in furnace coke values, recent advances not now being obtained by ovenmen, and mainly on this account consumers of pig iron were enabled to sway some sellers and induce them to accept 1s. per ton less than the generally quoted figures of £3 5s. for Northamptonshire foundry and £3 7s. 6d. for Derbyshire. There were furnacemen who held out for the full quoted prices, but it was possible to do business at £3 4s. for Northamptonshire and £3 6s. 6d. for Derbyshire. Demand shows no improvement on the week, and little expansion of business is now looked for until the opening of the new quarter. Forward contracting is practically non-existent, not being encouraged either by producer or consumer. There is little activity in the forge branch and quotations remain unchanged, Northamptonshire being at £2 17s. 6d. and Derbyshire at £3 2s. to £3 3s.

Staffordshire Bar Iron.

The price position with regard to Staffordshire bar iron remains unchanged. The marked bar makers, who are obtaining £14 per ton, have about sufficient work on hand to keep the mills steadily employed, but forward bookings are poor. A fairly large tonnage of Crown iron is going into the railway wagon building works. The general quotation remains at £11 10s., which is akin to the Lancashire quotation, though some houses are prepared to accept £11 5s. Strong appeals have been made lately to Staffordshire makers of nuts and bolts to use local iron as their base material, in view of the injury done to the British reputation by the use of Belgian iron frankly described by the sellers as "steely" and very liable to break down owing to its brittleness. The much lower price of continental nut and bolt iron, however, makes it extremely difficult for Staffordshire makers to do business at £10 10s. upwards. Now that the Charleroi strike has terminated and the works are almost in normal operation again, the Belgian makers of common bars have resumed their ascendancy. Shippers undertake to deliver within five to six weeks of receipt of order. They have advanced their price 2s. 6d. on the week, making it £6 17s. 6d. delivered here, but even that figure is such as practically to rule out Staffordshire iron, except for the most important work. The demand for wrought iron gas tube strip is maintained, and the selling price of £12 10s. is unchanged.

Galvanised Sheets.

The galvanised sheet trade continues brisk. The minimum price accepted for 24 gauge corrugateds this week was £16, but sales are being made at 5s. over this figure on forward account. The works are well situated for some time to come, and demand alike for home and export consumption is maintained, new business coming forward in sufficient quantities to replace the orders executed. Thinner gauges are fairly well called for. Midland motor engineers are taking good quantities of black sheets.

Manufacturers and Railway Delays.

Many complaints are being made by engineers, iron and steel manufacturers and other manufacturers in the Midlands and Staffordshire of railway delays, attributed to the lack of rolling stock, and especially of the "bolster" wagons required to convey long lengths of iron and steel. Energetic protests have been addressed to the railway companies on the subject, and it is likely that the Government will be appealed to. In one case, lately, it is stated, some steel urgently wanted was detained for a fortnight at the steel works through lack of transport.

Plant for Kent Coalfields.

I am given to understand that Nortons (Tividale), Ltd., constructional engineers, of Tipton, have been successful in securing the first orders for surface handling plant for the new Kent coalfield. The firm, it is stated, is to design, construct, and manufacture a complete plant for the Snowdown Colliery of Pearson and Dorman Long, for the handling of the trams of coal from the pit mouth to the screening plant, and also for the complete coal-screening plant, with buildings, &c. The coal will be sized for commercial and household purposes, and picked, cleaned and automatically loaded with the least possible breakage.

Cannock Chase Miners' Wages.

At a meeting on Monday of the Eastern Federated Area Wages Board, which controls Cannock Chase, the ascertainment of miners' wages for March showed that the minimum wage for stallmen would be 9s. 8d. per day, this being the same as for the past eight months. The March wages are based on the output and selling prices for the months of November, December and January.

Unemployment.

That a more active tone is developing in Midland industry is apparent from the continued decrease in the number of persons unemployed. The latest returns show the number of persons unemployed in the area as 121,320, as against 123,244 for the previous week, a decrease of 1924. Of these, 87,980 are men, 1536 boys, 28,670 women and 3134 girls. The number of persons on short time or temporarily employed is given as 37,078, as compared with 37,652 in the previous return. Of the twenty-two principal towns particularised in the returns, there was increased unemployment in only four, namely, in Cradley Heath, Stourbridge and Brierley Hill, Tipton, and Worcester. The total unemployed in the Birmingham area are now down to 23,277, while at Coventry the figure has fallen to 1340.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

THE centre of interest on the Lancashire iron and steel markets since my last report, now that the labour troubles that have been hanging over the engineering industry for so long have suddenly come to a head, has shifted completely. For some weeks previously the markets had undoubtedly been under the influence of the fear of what might happen in May in respect of the coal industry, and this uneasiness seemed to become more pronounced week by week, being reflected more particularly in an increasing reluctance on the part of users of iron and steel to spread their buying operations over a period. This factor of uncertainty, serious as it is in itself, has now more or less been relegated to the background by the more immediate and more direct danger which threatens the engineering industry and, with it, the iron and steel trades. If a stoppage does take place, a very serious and early effect upon the markets for iron and steel products in this district, small as has been the volume of business for some time, must result, for few parts of the country can claim the importance of Lancashire as an engineering centre.

Non-ferrous Metals.

In nearly every section of the non-ferrous metals market business is decidedly slow, and no improvement in buying operations since last week has occurred. Tin remains the one really strong metal of the group, and here we have a parallel almost to the phenomenal rise last year in rubber. With stocks at a low ebb and the probability, as far as the near future, at any rate, is concerned, of further reductions in available supplies, values remain very firm indeed, and in this market the likelihood of £300 per ton being touched is freely discussed. So far, however, the prospect of still higher prices has not tempted buyers here to come on to the market to any appreciable extent. Copper is another section in which comparatively little business is being done at the moment. On the whole, copper manufacturers are pretty well employed, but the trouble is that fresh orders are not coming in at a sufficiently quick rate to replace business now being turned out. The demand for spelter from the galvanising trade is slow, and galvanisers are buying very little of this metal at the present time, although the view has been expressed on 'Change here that they will be compelled to resume purchases on a bigger scale before long. The attitude of galvanisers, apparently, is one of watchfulness and caution in view of the attempts of American producers to stiffen prices. Lead is easier and current sales of this metal here are restricted. Some fairly good business has been reported within the last few days in copper tubes in connection with the portion of the London, Midland and Scottish locomotive contracts placed locally.

Iron.

In the iron market quotations are steady, producers holding firm to their rates in spite of the limited demand they are experiencing at the present time. As before, most of the business that is going through is for near delivery, inquiry for forward being poor and for comparatively unimportant quantities. The crisis in the engineering industry has undoubtedly affected this market, although one maker denied rather cynically that it had done so, basing his statement on the assertion that business has been so bad recently that it could not possibly have been worse. In the meantime, Lincolnshire, Staffordshire and Derbyshire No. 3 foundry pig irons, delivered equal to Manchester, continue round 76s. per ton, with East Coast hematite at 77s. 6d. per ton on trucks, and West Coast at round 92s. 6d. per ton, including delivery. The home trade demand for bar iron is rather slow, although there has been some business passing on export account. Lancashire Crown bars, delivered in this district, are maintained at £11 10s. per ton, and second quality material at £10 5s. Iron hoops are quoted at about £14 per ton.

Steel.

The position with regard to steel is about unchanged. There is certainly not a great deal of business being done, although some people are looking for an improvement towards the end of the month. This is subject, of course, to nothing untoward happening in the meantime, for otherwise the steel trade will be immediately affected by adverse developments in the engineering industry. At the moment the volume of inquiry is still very small, and there has been little fresh business to make for increased activity at steel works. Only a moderate quantity is being bought just now for constructional work, although several hundred tons were disposed of in connection with a contract at Ellesmere Port. Inquiry for plates also continues on a small scale. Steel bars are quoted at £7 12s. 6d. to £7 15s. per ton, angles and joists at £7 2s. 6d., plates at £7 12s. 6d., and ship plates at £7 15s. to £8 per ton, all delivered. Best steel hoops are at £13 5s., and soft steel hoops at £10 5s. per ton, less being quoted for export, though the latter branch is quiet just now Egypt having just finished buying and the Indian season not starting until about May. The demand for continental steels is slow, and delivery of material on order has been interfered with recently by strikes and floods on the Continent. For delivery equal to Manchester ordinary billets are at about £5 5s. per ton, sheet bars £5 10s. to £5 12s., joists £5 17s. 6d. to £6, ship plates £6 12s. 6d., Siemens' plates £6 17s. 6d., and steel bars £6 7s. 6d. to £6 10s. per ton. Several fairly big parcels of British galvanised sheets for India have been booked here, and prices for that market have now been reduced to £15 15s. per ton f.o.b.

Scrap.

In the scrap metal trade, both ferrous and non-ferrous, the demand is very poor, and values in most cases are easy. Scrap zinc is at £25 to £26, heavy copper at £61, best selected gun-metal £53, lead £32 to £33, and brass rod turnings £40 to £41, these prices being for graded and sorted qualities, delivered to buyers. Wrought iron scrap is still offered at 70s. per ton, ordinary machinery scrap at 70s. to 72s. 6d., and textile machinery scrap at 75s. to 77s. 6d. delivered, with mild steel at 55s. per ton on trucks in Manchester.

Institution of Civil Engineers.

The fifth annual dinner of the Manchester and District Association of the Institution of Civil Engineers was held at the Midland Hotel, Manchester, on Thursday, February 25th, under the chairmanship of Professor A. H. Gibson. Covers were laid for 120. Sir William Ellis, President of the Institution, was amongst the guests. The principal toast, namely, "The Institution of Civil Engineers," was entrusted, as is customary on these occasions, to a student of the Institution, and this year Mr. E. H. Wild performed the task in a very creditable manner. Sir William Ellis, who replied, complimented the proposer on the manner in which he had acquitted himself. He spoke very highly of the value of the provincial associations in presenting opportunities for taking part in debates and for developing powers of public speaking. The toast of "The Manchester and District Association" was proposed felicitously by Alderman H. Derwent Simpson, President of the Manchester Law Society, and in his reponse Professor Gibson alluded to the advantages derived from the formation of the Joint Committee of Local Chairmen who met periodically to discuss matters of local interest. "Our Guests" was proposed by Mr. G. S. Coleman, and acknowledged by Mr. Herbert Levinstein and Captain Bacon. Mr. W. B. Worthington

completed the list of speakers in proposing the health of the honorary secretaries, Mr. A. C. Dean and Mr. C. Peel, to whose endeavours much of the success of the evening's proceedings was due.

Manchester Association of Engineers.

A very instructive paper was read before the Manchester Association of Engineers on Friday, 26th ult., on the subject of the "Manufacture of 'News Print' Paper," the author being Mr. Sydney Richardson, of Bury. The subject is too comprehensive to be dealt with in much detail in a paper which has to be read in about one hour, but Mr. Richardson succeeded in compressing a good account of the processes and appliances involved in the manufacture of newsprint paper into the time allowed. The author's paper starting with lumbering in Scandinavia and Canada, passed on to describe the logging installations and pulp making plant. The grinding and disintegrating machines used were described in some detail. The sulphite pulp manufacture, screening, dehydrating and the final processes of making the endless sheets were all dealt with. One of the Fourdrinier machines illustrated on the screen was said to weigh about 1000 tons, required 800 to 1000 horse-power to operate, and produced 100 Canadian tons (2000 lb. per ton) of paper per twenty-four hours. Much interest was shown by the members present in the means employed to get rid of the water and moisture in the final processes. This is an immense problem in large factories, a machine delivering 100 tons of paper per day of twenty-four hours having to release 16,000 lb. of water per hour into the atmosphere of the machine house, and this moisture has to be got rid of. The author stated that for modern paper manufacture the all-electric mills are the most economical. The paper was very well illustrated by numerous lantern slides, and the discussion which ensued showed that the subject was full of engineering problems.

The Engineering Trades.

Although there is still ample room for further improvement, the reports of the past year's operations of several large local engineering establishments give cause for encouragement, provided there is no setback in the shape of labour troubles. Speaking at the annual meeting of the National Gas Engine Company, Mr. H. N. Bickerton, the chairman, reported that their improved profits were due to a considerable increase in the volume of business done during the last, as compared with the preceding, year. The principal increase in output was due to foreign orders, which had resulted, according to Mr. Bickerton, from the personal visits of two of the directors to Western Europe, South America and the Far East, thus anticipating the advice recently given by the Prince of Wales to make personal visits to foreign markets. Speaking at a meeting of shareholders in Mather and Platt, Ltd., Mr. Loris Mather, chairman, referring to the year's results, was able to record an increased volume of output, though the turnover of business was about the same as that of last year. Mr. Mather said that home business had maintained its volume, the depression in the colliery districts, where his firm normally looked for a large amount of electrical and pump business, having been balanced by the expansion of municipal undertakings and those industries unaffected by export conditions. Business relations had again been established with Russia, and he looked forward to a considerable extension of activities in that country. Egypt and the Sudan, Mr. Mather said, had contributed well, considering their size industrially, and the better prospects reported last year in South America had materialised. In the motor vehicle industry Leyland Motors, Ltd., had a very busy year, the output of vehicles of all kinds having greatly exceeded that of any previous year, the turnover having been over £2,488,000, an increase of 32 per cent. on the turnover for the previous year. Mr. Toulmin, the chairman of that company, said that they had now used up the huge stock of second-hand Government vehicles which were bought some years ago, just after the conclusion of the war, and that part of their operations had been financially satisfactory. It is encouraging to note that the company's model steel foundry at Farington was busy throughout the year. It is probable that at a not far distant date a scheme of reconstruction will be submitted to the shareholders of the company.

BARROW-IN-FURNESS.

Hematite.

There is just a little better tone in the hematite pig iron trade in the North-West Coast district, and it is possible that there will be a further improvement as soon as the industrial horizon is clearer. There are twelve furnaces in blast in the district, excluding the charcoal furnace at Backbarrow. There is not much iron going into stock, and much of what is is awaiting customers' orders. The Midlands continue to be the best customer, but there is a chance of more trade with Scottish buyers in view of the improvement in shipbuilding and engineering. The continental trade does not amount to much, and no doubt the fall of the French franc has had its effect upon the trade with that and other countries. American business is moderate and spasmodic. Scrap iron is being delivered at the Barrow Docks every now and then, and some of it is from the Continent.

Iron Ore.

The iron ore trade remains about the same. Its activity is practically dictated by the state of the local iron trade, as there is not much going outside the district. This trade may, however, improve in the future. Foreign ore is arriving at West Coast ports in restricted quantities.

Steel.

The steel trade is moderate. There are a few orders about, and the local works have business to keep them going for a short period, but fresh orders are necessary if the mills are to be kept going for any length of time. The Barrow and Workington mills are engaged on rails, the former regularly and the latter three weeks out of the four. Hoop and small section mills are better placed.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Trade.

THE heavy steel trade, which has had very much less than full employment for two or three years, is somewhat better situated at present, the output from the open-hearth department having been larger in February than in any month of last year. Prices, however, are weak, and unremunerative figures have been accepted for much of the recent business. Nor is the outlook satisfactory. There has been a falling off of forward orders to such an extent that, unless an early improvement manifests itself, a curtailment of production will be necessary soon. Rather more is being done in armour plate, and the appointment of a British Naval Mission to the Chilian Government encourages hopes of further business in that direction. The railway steel departments are still among the best employed on the heavy side, and they are receiving a steady flow of orders, but the individual quantities are not as large as could be desired. The electrical and general engineering trades of the country continue to give evidence of expansion, and are sending forward a fair amount of work to the local steel forges and foundries, but those establishments could deal with much greater demands than are at present being made upon them.

The Lighter Branches.

In the lighter and finished branches of the steel trade the position is not satisfactory. For some time this side has had less to complain about than the heavy department, and several of the trades have enjoyed much activity, but now, although bright patches can still be found, the general experience is that February was a period of declining business. The quietude affects even files, saws and edge tools, trades which have been busy for several years, and in which there is no serious continental competition. During the last year or two they have benefited to an increasing extent by trade with Russia, and they are now anxiously awaiting the placing of new orders by that country, which needs large supplies. It is expected that the orders will be sufficient to provide full work for the factories which are quiet at present. There is a somewhat improved demand for twist drills and other mechanics' tools.

Cutlery and Plate.

There is no improvement to record in the cutlery and plate trades, and little sign of the expansion which is usually seen a few weeks before Easter. The falling off in the output of stainless table knives continues, and has been very marked all through this year. An increasing share of this business is being done by small makers who can cut prices very severely, but even they are not so well employed as they were last year. Some of the large firms have lately made a reduction in their sale prices for cutlery of this class. The old-established houses are very poorly off for general trade, but a few of them have a good deal of work in hand in connection with special orders for catering equipment. In one case, a large order for the table furnishings of the Pullman cars running in this country has been booked, and there are also on hand contracts for plate and cutlery for several hotels and a Cunard liner.

Suggested Quality Marks.

A severe condemnation of British products has appeared in the *Saturday Review*, from a correspondent in Kenya, who states that he has seen German cutlery and American carpenters' tools which seem better made and of better material than anything from Birmingham or Sheffield. "Perhaps," he says, "I am comparing the best of Solingen and America with the worst of Sheffield and Birmingham. Still, there can be little excuse for the badness of some of my table knives." Representative Sheffield cutlery manufacturers interviewed with regard to this statement, denied that there was any falling off in the quality of high-class Sheffield goods, and suggested that the way to make sure of getting a good article was to select one made by a firm of established reputation. It is a well-known fact, however, that goods of inferior quality are sent out from the city, not only bearing the name of Sheffield, but even stamped with such marks as "Best Sheffield." The harm thus done to the city's trade has been recognised for a long time. It was discussed at a meeting of the Sheffield Advisory Committee last week, and the suggestion was put forward that the only way of meeting the situation was by grading the steels used and marking them according to quality.

An Order for Cement Plant.

The making of cement plant is a branch of engineering which has made much progress in Sheffield of late. The latest order of the kind to be reported is an additional one secured by Vickers Ltd. for the third unit for the Holborough Cement Works, Snodland, Kent. The plant comprises a kiln, cooler, wash mill and mixer plant.

Sheffield's Water Supply.

New works are being carried out by the Derwent Valley Water Board in order to give Sheffield its final instalment of supply from that great undertaking. The Board has two great reservoirs near Ashopton, Derbyshire, for the supply of water to Sheffield, Nottingham, Leicester, Derby, and parts of Derbyshire, and some day it will have to construct a third great dam. It is able to satisfy Sheffield's full requirements, however, without carrying out any great extensions. A weir is being built across the junction of the rivers Ashop and Alport in the Derwent Valley, and the water from these rivers will be diverted into the present Derwent reservoir. It is expected that the scheme will be completed within a few months. The construction of the new reservoir, already alluded to, is a matter for the future. When it is made it will submerge a great part of Ashopton village, Derwent Hall—a former seat of the Duke of Norfolk—and a stretch of the main road between Sheffield and Manchester, which will have to be re-made and carried over the dam on a viaduct. The need for this reservoir will arise when the other authorities forming the Board give notice that they require an increased supply, but, as that notice must be one of ten years, and as it is not being given at present, the likelihood is that the new dam will not be made for the next twenty years or more.

A Great Water Tower.

The building of a great ferro-concrete water tower to augment the water supply of Goole is now in an advanced state. It is expected that the work will be completed by June, when Goole will possess the largest tower of its kind in the country. It is to be 155ft. high, including the foundations, which are 10ft. deep. It has now risen to within a few feet of the tank floor. The tank will be 22ft. high and 90ft. in diameter, and will have a capacity of 750,000 gallons. It will be divided into two compartments. Including the water, the total weight of the structure will be between 7000 and 8000 tons. There is at present a brick water tower in the town, built over forty years ago, but its capacity is a mere 30,000 gallons, which is only equal to half an hour's supply. With the addition of the new tower, a full day's margin of supply will be available for a population of nearly 25,000. The tower is being built by Messrs. Arnold, contractors, of Doncaster, with Mr. E. J. Silcock, of London and Leeds, as consulting engineer, and the work has been in progress upwards of a year. The whole waterworks scheme, of which the tower forms part, is to cost £50,000. It also includes a new bore-hole, 600ft. deep, tested to 1,250,000 gallons per day, and new pumping machinery and other plant at Pollington, 10 miles west of Goole.

A Flooded Colliery.

The workings of Silkstone Main Colliery, near Barnsley, has been flooded by an inrush of water from old levels, and it has been decided to close the pit. Before the trouble made its appearance, the pit was working regularly six days a week, and producing a weekly average of 1200 tons of coal. The management had surmounted many difficulties, and installed new machinery, but it is felt that the small quantity of coal to be won does not justify expenditure on more powerful pumps to deal with the water. The electrical pumps, coal-cutting machines, &c., have therefore been brought to the surface, and the colliery is not to be reopened. About 200 men are affected.

Dewsbury Schemes.

The Corporation of Dewsbury has decided to reconstruct its sewage works at Ravensthorpe, and a Ministry of Health inquiry has been held with regard to an application for sanction to borrow the necessary £70,000. People of the Ravensthorpe district opposed the scheme, on the ground that the works ought to be removed and amalgamated with the Mitchell Laithes works, but on behalf of the Corporation it was pointed out that the trade effluent of Ravensthorpe could not be taken to Mitchell Laithes, although the domestic sewage could. The scheme has the support of the West Riding Rivers Board, whose representative stated that it was the only practical one for dealing with the great pollution of the Calder by manufacturers' effluent, and that if it were held up, the Board would have no alternative but to push forward its proceedings against individual manufacturers.

NORTH OF ENGLAND.

(From our own Correspondent.)

Industrial Revival Checked.

THE progress towards industrial revival in the North of England which has been in operation since the beginning of the year is now held up to a large extent through the threatened lock-out of the engineers and the uncertainty which still exists with regard to the Coal Commission's report and its ultimate effects upon the cost of industrial fuel. The trade revival is still a very delicate thing and under the rude shock of any industrial upheaval it would certainly perish. Thus manufacturers and traders are awaiting with great anxiety the development of the two crises now confronting industry generally. The fear of a possible disturbance has led to a shrinkage of business all round, and all that can be done is to wait until the horizon clears once more. But if wiser counsels prevail and industrial peace is established on a solid basis, there are good reasons to believe that the gradual improvement recently noted in the iron and steel trade will continue. Conditions abroad seem likely to turn in favour of British manufacturers, and, if so, they will be ready to grasp the opportunity.

Iron and Steel Exports.

The gradual improvement which has taken place in the iron and steel trade is reflected in the exports from Cleveland, which during the past four months have been as follows:—November, 85,667 tons; December, 89,401 tons; January, 92,630 tons; and February, 97,910 tons. During the month of February foreign shipments of pig iron showed a marked decline. Even including a shipment of 4000 tons to America, the total was only 14,680 tons, or 4000 tons less than in January. This, however, was largely due to the fact that home demands have been so urgent that the makers had little to spare for export, and indeed have been in arrears with deliveries for home consumers. On the other hand, the total of 63,644 tons of manufactured iron and steel shipped in February was only once exceeded last year, and compares with 56,611 tons in January. Over 10,000 tons were shipped to South and East Africa, and there are hopes of further big orders from this quarter. India was another big customer with 15,600 tons, while Egypt received 6792 tons, Australia 5300 tons, and Natal 4100 tons. Of the pig iron exported 19,586 tons went coastwise, 14,300 tons going to Scotland. The

principal foreign customers were America, 4000 tons; Belgium, 2291 tons; Denmark, 2091 tons; and Italy, 1500 tons.

Cleveland Iron Trade.

A much quieter tone characterises the Cleveland pig iron market. Business is now on an extremely limited scale, and as yet there is an absence of the spring buying generally looked for in the early days of March, but the undertone of hopefulness continues. In nearly all branches buyers are inclined to act with caution, but while orders are not coming forward in anything like the volume that could be desired, and works are running at far from full capacity, manufacturers have a fair number of contracts in hand, and requirements of the near future promise to necessitate a little more inoperative plant being restarted. As yet the Cleveland ironmasters show no signs of yielding with regard to prices, but the export figures reveal to what small proportions foreign business has been reduced, and only by lower prices is there any hope of expansion in that direction. Moreover, in the Scottish market iron from other areas is successfully competing with Cleveland, and this all strengthens the view that prices will have to come down. Makers, however, claim that there is little margin of profit, and adhere to recent quotations, No. 1 being 72s. 6d.; No. 3 G.M.B. Cleveland, 70s.; No. 4 foundry, 69s.; and No. 4 forge, 68s. 6d. All these are home prices, 6d. per ton more having to be added in the case of export orders.

Hematite Pig Iron.

There is a limited demand for East Coast hematite, but not sufficient to absorb the whole of the output, and an expansion in foreign business would be welcomed. Few export orders are coming to hand, and although makers have very small stocks they would welcome more business. Mixed numbers are quoted at 77s. 6d. per ton, and No. 1 quality at 78s. per ton.

Ironmaking Materials.

Recent heavy imports of foreign ore have taxed consumers' storage capacity and have largely overtaken arrears of deliveries. Sales are few and small, and little business is looked for until stocks have been somewhat reduced. Quotations are hardly so firm as they have been. Best Rubio ore is no more than 21s. 3d. per ton c.i.f. Tees. Blast-furnace coke is in ample supply, and with consumers well bought, a further fall in prices would cause no surprise. Good average qualities range from 19s. to 20s. per ton delivered at the works.

Manufactured Iron and Steel.

There is little change of note in the manufactured iron and steel trade. Orders are not by any means as plentiful as manufacturers would wish, and only in exceptional instances is plant fully employed. Some big orders for railway material are being executed in the district, but the plate mills could cope with a good deal more work. Prices are unaltered.

The Coal Trade.

The prospects are not so encouraging in the Northern coal trade. The inquiry has fallen away to a marked degree, and there are no present signs of recovery. Whatever may be the ultimate outcome of the Coal Commission's report, there is a widespread feeling that a national stoppage at the pits will be avoided, and so there is no move to lay in stocks for an emergency. The present level of prices is not attractive to foreigners, who have coal other than British to draw upon, and are therefore quite prepared to await developments. More tonnage would be welcome to deal with the orders in hand, and where prompt shipment can be assured, coal through contractors may be obtained at figures below current quotations. Collieries are steadily getting through their present bookings, and fresh business for them is coming in very slowly. Direct, the fitters do not show any disposition to recede from lately quoted prices. In the Northumberland steam coal section, producers at least seem to be well stemmed for prompt positions, but second-hand holders are not nearly so favourably placed. The latter have plentiful supplies, and, with only a poor market, they are conceding discounts to effect sales. Nominal quoted values for best Blyth steams are 15s. 9d. to 16s., and 15s. 6d. to 15s. 9d. for Tyne primes. Durham coal supplies are more abundant and values, if unchanged, tend downwards. Best gas coals are quoted from 17s. 6d. to 18s., and seconds at 15s. Most coke makers are still faced with a demand much smaller than the supply, and prices are not easy to maintain. The market for the most part is nominal, with quotations remaining at 22s. to 23s. 6d. for gas makes, 18s. to 20s. for patent oven sorts, and 30s. to 32s. for beehive sorts.

Imports of Iron and Steel.

Imports of iron and steel to the Tees still continue on a fairly heavy scale. Statistics presented at this week's meeting of the Tees Conservancy Commission showed that the imports of pig iron for the four months ending February from European countries, India and coastwise, totalled 21,200 tons, as against 3957 tons a year ago, and 54 tons in the pre-war period of 1913-14. Crude sheet bars, billets, blooms, and slabs unloaded to the end of February amounted to 52,420 tons, as against 40,166 tons a year ago, and 14,309 tons in the pre-war period, and plates, bars, angles, rails, sheets and joists imported were returned at 4780 tons, as against 7513 tons a year ago and 7906 tons in the pre-war period.

SCOTLAND.

(From our own Correspondent.)

Clyde Shipbuilding.

THE output from Clyde yards during the month of February, amounting to thirteen vessels of 34,077 tons aggregate, compares with twelve vessels of 40,936 tons in February, 1925, while the returns for January and February this year of twenty-five vessels of 50,999 tons, compare with twenty vessels of 69,502 tons aggregate in the same period in 1925. No vessel of outstanding size was launched, the list including four ships of 5000 tons and over and one vessel between 4000 and 5000 tons. The number of contracts reported during January and February of this year is unusually large, and there is distinct promise of much busier times, especially on the upper reaches of the river. As keels are laid down, additional men are bound to be employed. New contracts include a light cruiser and four gunboats, while motor ships figure largely. Although the position has improved by virtue of these contracts, the future is again rendered uncertain by the possibility of trouble in the engineering trades, but with this eventuality safely disposed of the future would be distinctly promising.

Important Ironworks Decision.

Some time ago the management of the Summerlee Ironworks intimated to the men that unless a wages reduction of 20 per cent. was conceded the works would have to close down. The men refused this concession, and the works were closed down. The men claimed unemployment benefit on the ground that the employer was seeking to break a trade agreement. On the case being taken up by the Iron and Steel Trades Confederation a court of referees decided in favour of the men. The insurance officer appealed against that decision to the umpire. The umpire has also now decided in favour of the men. Consequently all workmen thrown idle by the dispute will receive unemployment benefit.

Steel and Iron.

Conditions at the steel works are not greatly changed as yet. A quiet but steady demand for plates is experienced, but sections are slower, owing to the difficulty in making up sufficient quantities for rolling. The demand for steel sheets is quite up to expectation. The lighter gauges are especially busy, particularly for export. Galvanised varieties are in good all-round demand. Prices are firmly maintained, especially for export. Bar iron is in moderate demand, but a further increase in business would be very welcome. The re-rolled steel section of the bar iron trade is moderately well placed. Steel bars and small sections, also rounds and squares, are in fairly satisfactory demand. Business in pig iron is confined to a comparatively small tonnage, the demand being chiefly confined to immediate requirements. Prices generally are steady.

Coal.

The weakening tendency in the coal market continues without interruption. All descriptions of large and small fuel are being pressed for sale, owing to exporters failing to take up full commitments. Many sidings are congested with wagons of unsold coal, and good quantities can be secured at comparatively cheap rates. Ayrshire fuels provide the exception to the rule, these descriptions being in good demand for shipment to Ireland. Aggregate shipments amounted to 255,432 tons, against 245,024 tons in the preceding week and 248,816 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THE conditions in the steam coal trade have developed particular quietness, and the only construction that can be placed upon this fact is that buyers are holding off pending the report of the Coal Commission. If, as has been suggested in some quarters, this report is likely to form the basis of a settlement of the trouble as between the coalowners and the miners, then there will be no necessity for buyers to be in a hurry to cover for supplies, and no doubt the majority of them will look for easiness in market values. Certainly, while the report of the Commission is awaited with interest, there does not appear to be very real anxiety as to what it contains. As a rule, the Stock Exchange forms something in the nature of a barometer, and it is significant that during the past week the tendency of colliery shares, or at any rate of a number of them, has been to show appreciation. It can scarcely be believed that this advance has taken place on the expectation of colliery undertakings being materially nearer to being able to pay dividends or higher distributions, as the case may be, but it is attributed to the real belief that as the result of the Commission's recommendations something will be done in the grouping line. The only fresh inquiries that have come on the market are for rather more than 30,000 tons of best Admiralty large coals for the Palestine Railways, to be delivered at Haifa over a period of six months commencing April, while the Egyptian State Railways have intimated that they will be requiring tenders for 150,000 metric tons of Admiralty and Monmouthshire large coals. The definite period of delivery is not yet known, but it is assumed that the coals will have to be shipped to Alexandria from about May to July. Apart from these, the demand both for prompt and forward delivery is comparatively quiet, and although most of the leading colliery undertakings report that they are well sold for the whole of this month, the market displays irregularity for the reason that the tonnage position continues to be somewhat unsatisfactory. There should be some improvement in view of the amount of tonnage which has recently been chartered, but for the past few weeks expectations in this direction have been so disappointing that it is unsafe to hold out great hopes in this respect for the immediate future.

Cambrian Settlement.

At last a complete settlement has been arrived at whereby a restart of work at the Clydach Vale pits, belonging to the Cambrian Combine, is made possible. As previously mentioned, after an agreement had been reached with the miners, trouble arose with nine enginemen, but on Saturday last representatives of the winding enginemen met the general manager and, after several hours' negotiations, a compromise was reached, the men agreeing to accept a reduction in their rates from 8s. 11d. to 7s. 9d., plus certain privileges, instead of 7s. 6d. The management is therefore proceeding with arrangements for a resumption of work and for putting the pits in order. A few horses were to be taken down the pits on Monday last. After such a long stoppage as eighteen months, some time must elapse before the workings can be made safe for the miners, and doubtless the repairers will be busy for a week or two.

Coalfield Returns.

The report of the joint auditors was received on Tuesday, and it shows that there was a slight improvement in coal production in South Wales during the month of January, compared with December, though it was slightly less than the output in January, 1925. The output for January was 4,082,289 tons, as against 4,007,950 tons in December and 4,161,215 tons in January, 1925. The average proceeds per ton were:—January, 1926, 15s. 2.83d.; December last, 15s. 7.36d.; and January, 1925, 18s. 4.41d. The average wage per man-shift worked continues round about 10s. 8d., which shows very little variation during the past twelve months. The output per man-shift was 17.04 cwt. in January, compared with 16.92 cwt. in December and 16.67 cwt. twelve months ago. The trading results, apart from the subsidy, showed a loss in January of £555,906, equal to 2s. 8.68d. per ton. The subsidy averaged 4s. 1¾d. per ton on all the coal raised. The wages payable by the owners during the month of March will be .36 per cent. less than the standard rate of 1915, compared with .89 per cent. in February. The difference between this decrease and the minimum wage of 42.22 above the 1915 standard rate will be paid from the subsidy. The average wage per man-shift received by the workmen during January was stated to be 58 per cent. above the 1914 wages, while the cost of living in that month was 75 per cent. above the pre-war cost.

A Hopeful Sign.

It was announced on Monday that immediate steps are to be taken to restart the blast-furnaces at Blaenavon, which have been idle for several months.

Contracts.

In connection with contracts placed by the London, Midland and Scottish Railway, Hall, Lewis and Co., Ltd., of Cardiff, have received orders for 600 wagons, 500 of which are for merchandise and 100 cattle vans, 50 with automatic couplings and 50 without automatic couplings. The work will be carried out at Cardiff. The same firm has also orders for a number of 12-ton wagons for use at Welsh anthracite collieries and for fifty 20-ton steel wagons for the Great Western Railway. The Cardiff Electricity Committee decided on Wednesday to recommend the City Council to accept the tender of the Belgian firm, the Ateliers de Constructions Electriques de Charleroi, of £8818 for the supply of low-tension paper-insulated cables. The three lowest tenders were by foreign firms, Belgian, Italian, and German. The tender of the Belgian firm was £2188 below the lowest British tender. The tender of Messrs. Mather and Platt at £6505 was accepted for a 2000-kilowatt rotary converter for the Hayes substation, and that of the General Electric Company of £6502 11s. for a similar rotary for the Roath power station. The Coal Committee of the Cardiff Corporation has decided to accept the tender of the Powell Duffryn Steam Coal Company at 12s. 5d. per ton delivered for 40,000 tons of washed duff coal over a period of twelve months for the Roath electric power station.

Current Business.

The steam coal market continues to show some irregularity in prices for prompt shipment, this being entirely due to the inadequacy of ready tonnage. The week was started with a number of loading berths being unoccupied, owing to the arrivals over the week-end having been disappointing, the consequence being that some of the collieries continue to find difficulty in getting clearance of their wagons. Collieries are only making concessions, however, for quick shipment, and are not disposed to make reductions for supplies for forward delivery. The foreign demand rules quiet in practically all directions, and it is evidence that buyers are adopting a waiting policy. On the whole, prices are much the same as a week ago, so far as coals are concerned, but patent fuel prices show a tendency to harden, this being mainly due to the substantial addition to the costs of manufacture owing to the price of pitch having so sharply increased. Quite recently the price of pitch was approximately 45s. per ton, but it is now round about 85s., an advance of 20s. per ton having taken place in the past week or two. Pitwood is also firm at 40s. to 42s. 6d., as the result of the continuation on strike of pitwood workers at Bordeaux and adjoining French ports. This is becoming an increasingly serious matter for collieries.

THE MOTOR LINER ASTURIAS.—In the short reference made to the water-tight bulkhead doors on the Asturias in last week's article, it was not perhaps made sufficiently clear that J. Stone and Co.'s standard system for hydraulically controlling the bulkhead doors from the bridge was installed. On the Asturias the doors are hydraulically controlled, as in any other of the firm's installations, but as steam is not available for the purpose, the pumps for maintaining the hydraulic pressure on the system are electrically driven and are placed in the engine-room hatch.

ROYAL INSTITUTION.—A general meeting of the members of the Royal Institution was held on Monday afternoon, March 1st, Sir Edward Pollock, vice-president, in the chair. The death was announced of Dr. H. K. Onnes, an honorary member of the Institution, and a resolution of condolence with the family was passed. Miss M. S. Barlow, Dr. W. A. Caspari, Sir James Frazer, Lady Frazer, Mr. R. H. Hayes, Mr. W. Hawthorne, Mr. C. Judson, Miss I. E. Knaggs, Lady Jane Lindsay, Mr. H. H. Macdonald, Mr. P. Nelson, Mr. J. H. Reynolds, Mr. R. Soames, Rev. C. R. Shaw Stewart, Major D. Thompson, and Miss M. Walters were elected members.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	21/-
(1) Spanish	18/6
(1)N. African	18/6
N.E. Coast—	
Native	—
Foreign (c.i.f.)	21/3

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 17 0	—
No. 1 Foundry	3 19 0 to 4 1 6	
No. 3 Foundry	3 16 6 to 3 19 0	
N.E. Coast—		
Hematite Mixed Nos.	3 17 6	3 17 6
No. 1	3 18 0	3 18 0
Cleveland—		
No. 1	3 12 6	3 13 0
Silicious Iron	3 12 6	3 13 0
No. 3 G.M.B.	3 10 0	3 10 6
No. 4 Foundry	3 9 0	3 9 6
No. 4 Forge	3 8 6	3 9 0
Mottled	3 7 6	3 8 0
White	3 7 6	3 8 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 4 0 to 3 4 6	
,, Forge	2 16 0 to 2 17 0	
(3) Derbyshire—		
No. 3 Foundry	3 7 6	—
Forge	3 2 0 to 3 3 0	
(3) Lincolnshire—		
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 10 0 (a), 4 12 6 (b), 4 17 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	11 5 0	—
Best	—	—
N.E. Coast—		
Common Bars	11 0 0	—
Lancs.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	—
S. Yorks.—		
Crown Bars	12 10 0	—
Best ,,	13 10 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	11 0 0 to 12 0 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 11 0 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	11 0 0	—
Ship Plates, ½in. and up.	7 10 0	—
Sections	7 0 0	—
Steel Sheets, under 3/16in. to ½in.	9 0 0	—
Sheets (Gal. Cor. 24 B.G.)	—	£17 to £18

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E Coast—		
Ship Plates	7 7 6	—
Angles	7 0 0	—
Boiler Plates	11 10 0	—
Joists	7 0 0	—
Heavy Rails	8 0 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 0 0†	—
Light ,,	8 5 0 to 8 10 0	
Billets	7 10 0 to 9 0 0†	
Manchester—		
Bars (Round)	8 0 0 to 8 5 0	
,, (others)	8 0 0 to 8 5 0	
Hoops (Best)	13 5 0	13 0 0
,, (Soft Steel)	10 0 0	9 15 0
Plates	7 12 6	—
,, (Lancs. Boiler)	11 10 0	—
Sheffield—		
Siemens Acid Billets	10 10 0	—
Bessemer Billets	11 5 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	6 15 0 to 7 0 0	
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
Midlands—		
Small Rolled Bars	7 17 6 to 8 0 0	
Billets and Sheet Bars	6 0 0 to 6 2 6	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 0 0 to 16 5 0	
Angles	7 0 0 to 7 5 0	
Joists	7 0 0 to 7 5 0	
Toes	8 2 6 to 8 5 0	
Bridge and Tank Plates	7 17 6 to 8 0 0	
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	19/3 to 19/6
Block Tin (cash)	294 12 6
,, (three months)	284 10 0
Copper (cash)	58 7 6
,, (three months)	59 7 6
Spanish Lead (cash)	32 5 0
,, (three months)	32 6 3
Spelter (cash)	34 15 0
,, (three months)	34 16 3
Manchester—	
Copper, Best Selected Ingots	64 10 0
,, Electrolytic	66 10 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 1
Brass Tubes (Basis Price)	0 1 0
,, Condenser	0 1 2½
Lead, English	34 15 0
,, Foreign	33 10 0
Spelter	36 0 0

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/1 to 2/2 per lb.	
Ferro Tungsten	1/11 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 10 0	7/6
,, 6 p.c. to 8 p.c. ,,	£22 0 0	7/3
,, 8 p.c. to 10 p.c. ,,	£21 0 0	7/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£40 0 0	14/-
,, ,, 1 p.c. ,,	£46 0 0	14/6
,, ,, 0·70 p.c. carbon	£56 0 0	17/6
,, ,, carbon free	1/5½ per lb.	
Metallic Chromium	3/9 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 15 0 scale 5/- per unit	
,, ,, 75 p.c.	£21 0 0 scale 6/- per unit	
,, Vanadium	15/- per lb.	
,, Molybdenum	6/- per lb	
,, Titanium (carbon free)	1/- per lb.	
Nickel (per ton)	£172 to £175	
Cobalt	10/- to 11/- per lb.	
Aluminium (per ton)	£120	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	15/3
,, ,, Ell	15/6
,, ,, Splint	16/6 to 18/6
,, ,, Trebles	15/3
,, ,, Doubles	13/9
,, ,, Singles	12/6
Ayrshire—	
(f.o.b. Ports)—Steam	16/-
,, ,, Jewel	17/-
,, ,, Trebles	16/3
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	12/9 to 15/-
Screened Navigation	21/-
Trebles	15/- to 18/-
Doubles	12/9
Singles	12/-
Lothians—	
(f.o.b. Leith)—Best Steam	14/-
Secondary Steam	13/3
Trebles	14/9
Doubles	13/6
Singles	12/6

ENGLAND.

(8) N.W. Coast—	
Steams	24/6
Household	40/- to 48/-
Coke	26/-
Northumberland—	
Best Steams	15/6 to 16/-
Second Steams	14/6
Steam Smalls	8/- to 8/6
Unscreened	14/-
Household	20/- to 22/-
Durham—	
Best Gas	17/6 to 18/-
Second	14/6 to 15/-
Household	20/- to 22/-
Foundry Coke	18/- to 20/-

Sheffield—	Inland.
Best Hand-picked Branch	31/- to 34/-
Barnsley Best Silkstone	28/- to 30/- —
Derbyshire Best Brights	26/- to 28/- —
,, ,, House	24/- to 25/- —
,, ,, Large Nuts	17/- to 20/- —
,, ,, Small	12/6 to 14/- —
Yorkshire Hards	17/- to 19/6 —
Derbyshire ,,	16/- to 19/- —
Rough Slacks	10/- to 12/6 —
Nutty ,,	7/6 to 9/- —
Smalls	3/6 to 6/- —
Blast-furnace Coke (Inland)*	— —
,, ,, (Export)	f.o b. 19/- to 20/-

Cardiff— (9) SOUTH WALES.	
Steam Coals:	
Best Smokeless Large	23/- to 24/-
Second ,, ,,	21/6 to 22/6
Best Dry Large	21/- to 22/-
Ordinary Dry Large	20/- to 20/6
Best Black Vein Large	20/6 to 21/-
Western Valley Large	20/- to 20/6
Best Eastern Valley Large	20/- to 20/6
Ordinary ,, ,,	19/- to 20/-
Best Steam Smalls	12/- to 13/-
Ordinary ,,	11/- to 12/-
Washed Nuts	19/- to 20/-
No. 3 Rhondda Large	27/- to 27/6
,, ,, Smalls	16/- to 16/6
No. 2 ,, Large	19/6 to 20/6
,, ,, Through	16/- to 17/-
,, ,, Smalls	10/6 to 11/-
Foundry Coke (export)	37/6 to 40/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	20/- to 22/6
Pitwood (ex ship)	40/- to 42/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	40/- to 41/-
Seconds	30/- to 32/6
Red Vein	27/- to 30/-
Machine-made Cobbles	50/- to 52/6
Nuts	50/- to 52/6
Beans	42/6 to 45/-
Peas	21/- to 24/-
Breaker Duff	7/- to 7/6
Rubbly Culm	9/- to 9/9
Steam Coals:	
Large	22/- to 23/6
Seconds	20/- to 22/-
Smalls	9/- to 10/-
Cargo Through	16/- to 17/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations according to analysis; open market, 17/6 to 19/- at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Import Duties.

THE Government has introduced into the Chamber of Deputies its Bill for increasing the import duties on practically all goods by 30 per cent. It repudiates the idea that the duties are raised solely with the intention of increasing the revenue, and affirms that the proposed new tariffs are fully justified by the continued depreciation of the franc, which, despite the coefficients, nullifies the effect of the existing rates as a protection for home industries. So far there has been no complaint from manufacturers that their interests are jeopardised by the lower value of the national currency, for, while the imports were, until recently, seriously restricted by what were almost prohibitive prices and exports were increasing because French makers could produce more cheaply than most of their foreign competitors, there was no necessity to start upon a new policy of fiscal protection that might provoke retaliation from other countries. It is certain that the situation is not quite the same as it was some time ago, and the present trade stagnation, coupled with the increasing imports and dwindling exports of the past two months, may seem to justify the proposal to raise the duties, but manufacturers particularly object to a fiscal system which would seriously increase the cost of raw material and advance selling prices on the home market. If the Government intended merely to increase the duties by 30 per cent. it would be bad enough, but the situation is complicated by the decision of the Senatorial Budget Commission to recommend the payment of import duties on a gold basis. The idea is to reduce the burden upon taxpayers as much as possible by putting it upon the shoulders of those who purchase foreign goods, and it is therefore proposed to raise the duties on foreign products, payable on a gold basis, and to leave raw material practically free, as it is at present. That course would remove the objections of those who fear that the 30 per cent. increase on everything would enhance costs on the home market, and the Senatorial Commission looks to the new duties to provide a huge surplus which will compensate for the suppression of certain new taxes. It is probable that the two proposals will be merged into one in a way that will provide a heavy increase in import duties, and it will certainly have the effect of checking the improvement which has recently been observed in foreign imports.

Credit Restrictions.

The report that a leading metallurgical concern near Saint-Nazaire has gone into liquidation and that the works will probably be closed, thereby throwing out of employment more than 2000 men, has caused so much consternation in the district that the various local bodies are considering whether something cannot be done to keep the works going until confidence in the industrial situation is restored. There are many other firms throughout the country which find it difficult to keep afloat in the absence of credit facilities. So long as there is no confidence in the immediate future, and no one can foresee what are likely to be the new taxation proposals, the banks and financial houses are reducing credits to a strict minimum. It may even be said that such credits are scarcely obtainable at all. This lack of confidence is due solely to what are regarded as temporary causes, and when the taxation proposals are finally settled and capitalists know exactly in what position they stand, it is believed that trade and industry will start upon a new era of activity, owing largely to the huge amount of money which is to be spent upon public works alike at home and in the Colonies. Business from colonial sources is rapidly increasing, and while in Madagascar an important programme is to be carried out with revenue derived from taxation, engineering enterprise will become particularly active in the West African Colonies as soon as the financial situation is stabilised.

Fuel Economies.

A further report issued by the Commission Interministérielle d'Utilisation des Combustibles deals with the economies effected in coal consumption during 1924 by the various municipal pumping and other stations in Paris. Those economies were obtained simply by ensuring a more efficient firing of the boilers and by a more careful attention to the running of the engines whereby the cost of maintenance and repairs was reduced. During the year the total economy realised was 810,000f., representing 18½ per cent. It allowed of all the members of the staff receiving premiums considerably in excess of what had been paid them previously. Recording instruments, which enabled the men to see for themselves the results they were achieving in the way of economising coal, were used, and as the men are perfectly satisfied with this new premium system it is likely to be further extended.

Seaplane Trials.

The last seaplane trials at Saint Raphael failed so utterly through the absence of satisfactory regulations that particular attention is given to the organisation of a trial of multi-engine commercial machines for which prizes amounting to 800,000f. are offered by the Sous-Secrétaire d'Etat de l'Aéronautique. The machines must each have at least two engines developing a total of 500 horse-power minimum. The tanks must have a capacity allowing the seaplane to cover 500 kiloms. against a head wind having a velocity of 10 m. per second and at a speed to be fixed later on. The machine must be able to carry one passenger per 150 nominal horse-power and a commercial load of 150 grammes per nominal horse-power. In the eliminating trials the machine must fly for half-an-hour with one engine stopped at an altitude between 700 m. and 200 m.; it must rise to an altitude of 2000 m. in less than thirty minutes; the minimum speed on an 8 kilom. base must be 160 kiloms. an hour; there will be a test of navigability on water and of wireless during flight. After passing through the eliminating and technical tests the competing machines will have to cover each day, during the four days of the trials early in August, about 500 kiloms. The results of the commercial test will be based upon a formula in which the useful load is multiplied by the commercial speed and the product is divided by the fuel consumption.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

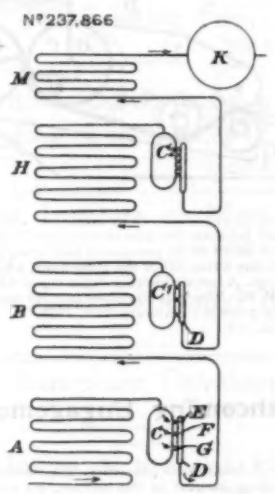
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

237,866. April 9th, 1925.—IMPROVEMENTS IN OR RELATING TO HIGH-PRESSURE STEAM GENERATORS, Sulzer Frères Société Anonyme, Winterthur, Switzerland.

This invention relates to water-tube steam generators of the kind in which the working fluid is caused to pass in a continuous stream through intermediate distributing and mixing chambers interposed between the various tubular sections of the generator. A portion of the working fluid is evaporated in the pipe coil A, and passes into the chamber C. From the chamber C the steam and water mixture passes through the throttled openings E, F, G into the pipe D, and in that way is supplied to the further group of tubes or to the coil B. When irregular vaporisation takes place in the coil A and a constantly varying mixture of steam and water passes into the drum C, the constituents of this mixture are redistributed and throttled by passing through the throttled openings into the pipe D. Owing to the throttling

N° 237,866



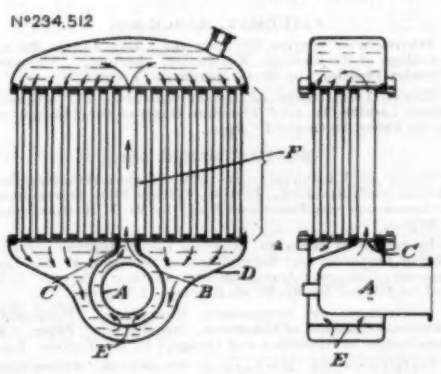
a drop of pressure takes place which produces further evaporation of the mixture, as it flows through the chamber, thus atomising any water it contains. Owing to this atomising the structure of the mixture is rendered more uniform, so that the working fluid supplied to the coil B is uniform in flow and mixture as regards specific steam quantity. In the tubular section B any further portion of the working fluid which has previously escaped being evaporated is now converted into steam and caused to flow into the chamber C^1, and thence through the throttled openings to the pipe D, where it undergoes further mixing and atomisation, before being supplied to a third tubular section H. In the chamber C^2 arranged between the coil H and superheater M the process described, which may be termed a process for refining steam, is repeated. After leaving the chamber C^2 the steam may be passed through the superheater M, so that the working fluid which is actually used in the engine K is perfect in every respect.—*January 28th*, 1926.

INTERNAL COMBUSTION ENGINES.

234,512. May 22nd, 1925.—IMPROVEMENTS IN OR RELATING TO WATER-COOLING SYSTEMS FOR INTERNAL COMBUSTION ENGINES, Max Michael, of Lohestrasse 64, Breslau 2, Germany.

The horizontal cylinder A is surrounded by the cooling jacket B, which is extended to form the connecting port C. The cooling

N° 234,512



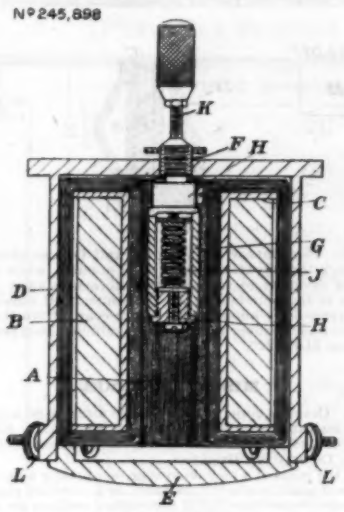
jacket is surrounded by the water-cooling tank D, which is put in communication with the interior of the jacket by means of the aperture E. The water tank forms a support for the radiator provided with cooling elements and an upward-flow pipe F.—*January 28th*, 1926.

TELEGRAPHS AND TELEPHONES.

245,898. November 29th, 1924.—IMPROVEMENTS IN AND RELATING TO TRANSFORMERS AND CHOKING COILS, ESPECIALLY FOR USE IN RADIO COMMUNICATION, Lissen Limited and Richard Percy Richardson, all of Woodger-road, Goldhawk-road, Shepherd's Bush, London, W. 12.

It is common practice to connect a resistance across the secondary terminals of the small transformers used for coupling thermionic valves together, or for coupling valves to telephones, in radio receiving apparatus, and this invention relates to an improved construction of such transformers or choking coils having a resistance combined with them. The wire core is indicated by A and the winding (if the device is a choking coil or auto-transformer) by B. There is a bobbin C upon which the windings are wound and through which the wires that constitute the core are threaded. The completed transformer is placed in a case D which may conveniently be cylin-

N° 245,898



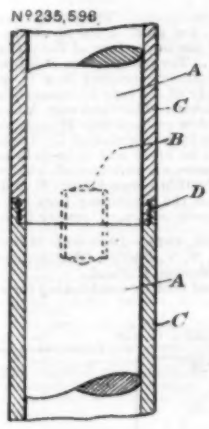
drical and permanently closed at one end. The other end is closed by a cover E. In the permanently closed end is a central hole to receive the threaded boss F of a carbon pile rheostat, which consists of the insulating tube G having metal caps H at its ends, and carbon discs J within it which can be pressed together by the threaded stem K which screws through the boss F. The boss projects outside the casing and a nut may be used to fasten the component into the deck or panel of a wireless set. The caps H are connected with the ends of the transformer winding, and the ends of the winding are brought out to terminals L mounted on the case.—*January 21st*, 1926.

FURNACES.

235,596. June 13th, 1925.—IMPROVEMENTS IN AND RELATING TO ELECTRODES FOR ELECTRIC ARC FURNACES, *International General Electric Company, Incorporated, of 120, Broadway, New York.*

Electrodes for arc furnaces have to conduct efficiently a considerable amount of current to the material being fused, and are usually composed of amorphous or graphitised carbon. These substances have great disadvantages as well as great advantages; their electric resistance is many times greater than that of metals and they have very little mechanical strength. Both these properties entail the use of electrodes with large cross sections and of great weight. Large cross sections entail the enlarging of the general dimensions of the furnaces or the omission of stuffings at the inlet points of the electrodes through the furnace walls or cover, and the considerable weight renders handling difficult. The object of this invention is to form electrodes for this purpose in which the current will be mostly conducted by metal whilst only the point of application of the arc consists of carbon. The electrode consists of a metal tube tightly surrounding a carbon rod. The metal tube is shrunk on the carbon rod while hot. The tube consists of the metal which is to be extracted, refined, or treated in some other way in the arc furnace. In electro-steel extraction the tube is of iron. The

N° 235,596



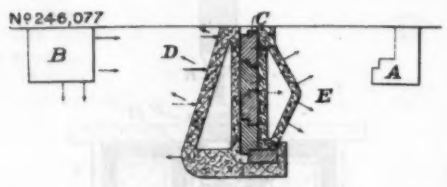
wall thickness amounts to from 4 mm. to 10 mm. By using an iron tube of this thickness the diameter of the electrodes can be considerably decreased. For example, an ordinary carbon electrode of 400 mm. diameter may be replaced by an electrode according to this invention of 250 mm. diameter. With such an electrode almost the entire current is conducted through the iron tube and only quite a small fraction, about a hundredth part, through the carbon core. Thus the voltage drop in the electrode is quite small and therefore the loss of energy entailed by this drop is also small. By means of the new electrodes the furnace economy is said to be considerably increased, and on account of the decreased diameter of the electrodes, room is made for the arrangement of stuffings without unduly enlarging the furnace cover and the furnace itself. The smooth surface of the electrodes greatly assists a good electrical contact with them. The electrodes can also be made up of successive pieces, and before the consumption of one electrode piece a fresh piece can be put in from the outside. In the accompanying drawing two pieces of carbon are indicated at A, and their tubular metallic covering at C, the latter having a screwed joint at D. The inside nipple B serves for preventing the stump of the lower carbon rod A from falling into the furnace after the complete burning out of the lower iron tube C. For the tube pieces C, waste from tube manufacturing can

easily be utilised, and they can be suitably cut and, if need be, provided with threads. The price of electrodes, according to this invention, will thus be small.—*January 21st*, 1926.

BUILDING.

246,077. December 6th, 1924.—PROTECTING BUILDINGS FROM VIBRATION, W. P. Digby, 91, Victoria-street, London, S.W.1.

The inventor proposes to protect the foundations of a building, such as that shown at A, from vibrations produced by machinery at, for instance, B, by means of a screen wall. This wall is composite as shown and has an intermediate layer C of resilient

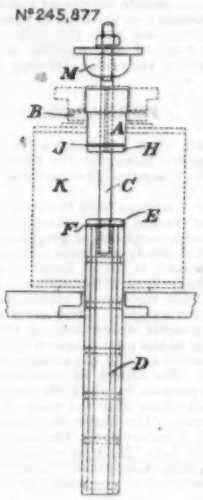


material. The contour of the outer wall D is so chosen as to reflect back the vibrations as far as is possible, while the inner wall E is designed to transmit the vibrations away from the direction of the foundations A. The outer wall should have a natural periodicity about 20 to 30 per cent. above that of the vibrations and the inner wall a correspondingly lower periodicity. —*January 21st*, 1926.

MISCELLANEOUS.

245,877. October 30th, 1924.—IMPROVEMENTS IN AND RELATING TO THE POLES OF MAGNETS OR SOLENOIDS, Allen West and Co., of Lewis-road, Brighton, and Robert Peel Bossom, of 1, Dover-road, Brighton.

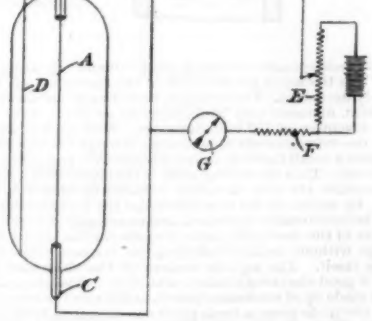
When the poles of a magnet system comprising a moving part and a fixed part—such, for instance, as a solenoid plunger and a fixed core—come together, if the contact surfaces are magnetic then when the current is cut off there is a difficulty in breaking the contact instantly. It is claimed that by this invention this difficulty is overcome. In the drawing A is a fixed cylindrical core, which is maintained in position by a washer B. Through this core a spindle C passes and it is screwed at its lower end into the upper portion of a laminated cylindrical plunger core D. At M there is a striking button, which operates a contact device



or other desired mechanism. The plunger core D is adapted to reciprocate freely, the limit of the up stroke being determined by the contact of the upper face of the plunger with the lower face of the core A. The plunger core D is provided with a comparatively thin magnetic contact face E, which is separated from the main body of the core by means of a thin washer F of non-magnetic material. The fixed core A is also provided with a comparatively thin contact face H separated from the main portion of the core by a thin washer J. A solenoid K causes the plunger core D to be lifted and to be held in contact with the core A until the current is switched off, whereupon, owing to the two comparatively thin contact faces E and H demagnetising more rapidly than the remaining portions of the cores, disengagement instantly occurs.—*January 21st*, 1926.

235,893. June 17th, 1925.—IMPROVED MANUFACTURE OF VERY THIN WIRES, N. V. Philips. Gloeilampenfabrieken, Emmasingel 6, Eindhoven, Holland.

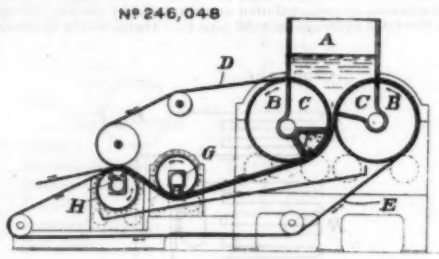
It has been found that by establishing for a considerable time



a glow discharge of sufficiently high current density between a wire which is to be made thin, and which for this purpose is connected as a cathode, and an auxiliary anode, the diameter of the cathode wire decreases and that in this manner wires can be made having a diameter of 1 micron or even less. The drawing shows a tungsten wire A having a length of 2 decimetres and a diameter of 50 microns and from which a very thin wire is to be manufactured. It is sealed at B and C into a glass bulb having a diameter of 6 cm. A second wire D, for example, of nickel, is also sealed into the bulb. The wire A, the ends of which are electrically connected to each other, is connected to the wire D through a potentiometer, the source of current for which has a pressure of 500 volts. The regulating resistance is shown at E, a resistance of 10,000 ohms at F, and a galvanometer at G, which permits readings of 0·1 milliampère. The bulb is filled with argon at a pressure of 0·2 mm. of mercury. By adjusting the sliding contact on the resistance E so that the galvanometer indicates a current of 1 milliampère the current density will be sufficiently great to cause the cathode to disintegrate. During the disintegrating process the thickness of the cathode wire can be tested by measuring the resistance of the wire. If the disintegrating process is continued until the resistance of the wire is increased to about twenty times the resistance of the original wire it appears that the cathode wire has a diameter of only a few microns. It is, however, possible to continue the process still further and thus to obtain wires having even a considerably smaller diameter. When the diameter of the cathode wire has been sufficiently reduced the wire may be removed from the bulb by breaking the seals B and C.—*January 21st*, 1926.

246,048. August 10th, 1925.—PAPERMAKING MACHINES, E. C. R. Marks, 57, Lincoln's Inn-fields, London, W.C. 2.

The inventors propose to expel the moisture from pulp which is in the process of being made into paper by blowing steam through the sheet. The pulp in the box A is attracted to the drums B B by a partial vacuum formed in the boxes C C and is



carried forward between the wire cloth bands D and E. Steam at a pressure of about 60 lb. per square inch is supplied at F and blows much of the water out of the pulp sheet, while it incidentally warms it up. A hot air blowing drum is provided at G and a suction box at H. The paper is subsequently subjected to the usual finishing process.—*January 21st*, 1926.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Chamber of Commerce, New-street, Birmingham. Paper, "Sewage Disposal," by Mr. J. B. Mayers. 6 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Yorkshire District meeting at Hull. Visit to cement works of G. and T. Earle, Ltd.

JOINT DELEGATIONS OF THE YORKSHIRE ASSOCIATIONS OF THE INSTITUTIONS OF CIVIL, MECHANICAL, ELECTRICAL, MUNICIPAL AND COUNTY, AND LOCOMOTIVE ENGINEERS.—Great Northern Hotel, Leeds. Dinner. 6.30 for 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Tendencies in Modern Electric Practice," by Mr. J. M. Seddon. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—The Engineers' Club, Waterloo-street, Birmingham. Paper, "Hoisting Appliances," by Mr. C. H. Woodfield. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "London Traffic," by Sir Henry Maybury. 9 p.m.

SATURDAY, MARCH 6TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—College of Technology, Manchester. Lecture, "Aluminium Foundry Practice," by Mr. G. Mortimer. 4 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "The Rare Gases of the Atmosphere," by Sir Ernest Rutherford. 3 p.m.

MONDAY, MARCH 8TH.

BRADFORD ENGINEERING SOCIETY.—Technical College, Great Horton-road, Bradford. Lecture, "Boiler Plant Developments in Association with Pulverised Fuel," by Mr. F. H. Rosencrants. 7.30 p.m.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Annual general meeting. Paper, "Nickel and its Alloys," by Mr. W. R. Barclay. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM CENTRE.—Chamber of Commerce, Birmingham. Paper, "The Metallurgist in Inspection and Design," by Mr. Topliss. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Graduates' meeting. "Aeroplane and Airship in Modern Air Transport," by Mr. S. S. Hall. 7 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS.—Abbey House, Westminster, London, S.W. 1. Students' meeting. Paper, "Contracts for Constructional Work," by Mr. H. J. Deane. 6 p.m.

SURVEYORS' INSTITUTION.—12, Great George-street, London, S.W. 1. Discussion of short papers on the New Law of Property. 8 p.m.

TUESDAY, MARCH 9TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Municipal College, Ormerod-road, Burnley. Paper, "The Usefulness of Wood Patterns Mounted on Boards," by Mr. A. E. Wilson. 7.15 p.m.

INSTITUTION OF AERONAUTICAL ENGINEERS.—Junior Institution of Engineers, 39, Victoria-street, London, S.W. 1. Paper, "The Development of Civil Marine Aircraft," by Mr. O. E. Simmonds. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: COVENTRY CENTRE.—Broadgate Café, Coventry. Paper, "The Preparation of Motor Cycles for Speed Events," by Mr. P. Brewster. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—North British Station Hotel, Edinburgh. Paper, "An All-electric House," by Dr. S. Parker Smith. 7 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Search for Oil in Australia," by Dr. Arthur Wade. 5.30 p.m.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Queen's Chambers, 5, John Dalton-street, Manchester. Paper, "The Origin of Rock Salt," by Mr. C. E. Newton. 4 p.m.

WEDNESDAY, MARCH 10TH.

ASSOCIATION OF ENGINEERING AND SHIPBUILDING DRAUGHTSMEN: BIRMINGHAM AREA TECHNICAL COMMITTEE.—Chamber of Commerce, New-street, Birmingham. Lecture, "Boiler-house Lay-out and Management," by Mr. P. S. Wooley. 7.30 p.m.

INSTITUTION OF CHEMICAL ENGINEERS.—Burlington House, Piccadilly, London, W. 1. Paper, "Refrigeration in Chemical Manufacturing Processes," by Mr. H. M. Dunkerley. 8 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—The University, Edmund-street, Birmingham. Paper, "Electro-farming or the Applications of Electricity to Agriculture," by Mr. R. Borlase Matthews. 7 p.m.

INSTITUTION OF ENGINEERS-IN-CHARGE.—St. Bride Institute, Bride-lane, Fleet-street, London, E.C. 4. Paper, "Modern Laundry Machinery," by Mr. E. A. Alliott. 7.30 p.m.

LIVERPOOL ENGINEERING SOCIETY.—The Temple, Dale-street, Liverpool. Paper, "The Flettner Rudder," by Mr. F. A. Best. 8 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Micro-structure of Coal," by Dr. Reinhardt Thiessen. 8 p.m.

WEDNESDAY AND THURSDAY, MARCH 10TH AND 11TH.

INSTITUTE OF METALS.—Institution of Mechanical Engineers, Storey's-gate, Westminster, London, S.W. 1. Annual general meetings. 10 a.m. each day. For programme see page 222.

THURSDAY, MARCH 11TH.

CHADWICK PUBLIC LECTURE.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "Housing, Past, Present and Future," by Mr. Alexander Harvey. 8 p.m.

CHEMICAL ENGINEERING GROUP.—Joint meeting with the Bristol Section of the Society of Chemical Industry at Bristol. 2.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "The Atom of Light and the Atom of Electricity—III.," by Dr. C. D. Ellis. 5.15 p.m.

FRIDAY, MARCH 12TH.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Metallurgical Department, University College, Singleton Park, Swansea. Discussion on "Annealing." 7.15 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Kinematograph Exhibition, showing the manufacture of a 50,000-kilowatt turbine and generator, the distillation of motor spirit and other subjects of engineering interest. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecturette, "Paint Spraying," by Mr. F. E. Webb. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Literary and Philosophical Society's Rooms, Newcastle-upon-Tyne. Paper, "What is Sea Speed?" by Mr. R. J. Eyres. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Radiation from Electric Discharges," by Sir J. J. Thomson. 9 p.m.

SATURDAY, MARCH 13TH.

ASSOCIATION OF MINING ELECTRICAL ENGINEERS: LONDON BRANCH.—Visit to Chislet Colliery, near Canterbury.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "The Rare Gases of the Atmosphere—II.," by Sir E. Rutherford. 3 p.m.

MONDAY, MARCH 15TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "Thermometry, I.," by Mr. W. F. Higgins. 8 p.m.

TUESDAY, MARCH 16TH.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Applied Science Department of the University, St. George's-square, Sheffield. Paper, "Aluminium: Where and how it is Made," by Mr. G. B. Brook. 7.30 p.m.

WEDNESDAY, MARCH 17TH.

INSTITUTION OF STRUCTURAL ENGINEERS.—Denison House, 296, Vauxhall Bridge-road, London, S.W. 1. Joint meeting with the British Section of the Society of Civil Engineers of France. Paper, "Notes on the Restoration of the Palace of Versailles and the Trianon," by Mr. A. Knappen. 8 p.m.

THURSDAY, MARCH 18TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Institute of Marine Engineers, 85–88, The Minories, London, E. 1. Paper, "The Preparation and Structure of Wires of Pure Tungsten," by Dr. C. J. Smithells. 7.30 p.m.

FRIDAY, MARCH 19TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate Westminster, London, S.W. 1. Paper, "The High-efficiency Oil Engine," by Mr. A. E. L. Chorlton. 6 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Victoria Hotel, Deansgate, Manchester. North-Western District meeting. Address on "New Legislation Affecting Local Authorities, including the Public Health Act, 1925, and the Roads Improvement Act, 1925," by Sir Lewis Beard. 2.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Pipe Work: Its Manufacture and Lay-out," by Mr. G. H. Willett. 7.30 p.m.

TUESDAY, MARCH 23RD.

INSTITUTE OF MARINE ENGINEERS.—85–88, The Minories, Tower Hill, London, E. 1. "Super-pressure Steam Generation," by Mr. D. Brownlie. 6.30 p.m.

FRIDAY, MARCH 26TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—92, Victoria-street, London, S.W. 1. Metropolitan District meeting. Paper, "The Life of Wood Paving as Affected by Expansion," by Mr. J. Garvie. 6.30 p.m.